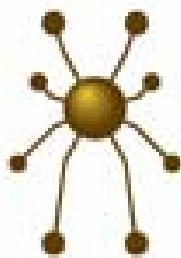


GigE Vision Dual Line Scan Camera



14-Jul-10
03-032-20027-02
www.dalsa.com



spyder GigE

Spyder3 Camera User's Manual

SG-11-01k80-00-R

SG-11-02k80-00-R

SG-11-04k80-00-R

SG-11-01k40-00-R

SG-11-02k40-00-R



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About DALSA

DALSA is an international high performance semiconductor and electronics company that designs, develops, manufactures, and markets digital imaging products and solutions, in addition to providing semiconductor products and services. DALSA's core competencies are in specialized integrated circuit and electronics technology, software, and highly engineered semiconductor wafer processing. Products and services include image sensor components; electronic digital cameras; vision processors; image processing software; and semiconductor wafer foundry services for use in MEMS, high-voltage semiconductors, image sensors and mixed-signal CMOS chips. DALSA is listed on the Toronto Stock Exchange under the symbol "DSA". The Company has its corporate offices in Waterloo, ON and over 1000 employees world-wide.

For further information not included in this manual, or for information on DALSA's extensive line of image sensing products, please call:

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1

Spyder3 GigE Vision Camera

1.1 Camera Highlights

Features and Programmability

- Broadband responsivity up to $408 \pm 16 \text{ DN}(\text{nJ}/\text{cm}^2)$ @ 10dB gain
- 1024, 2048, or 4096 pixels, $14\mu\text{m} \times 14\mu\text{m}$ (1k and 2k) and $10\mu\text{m} \times 10\mu\text{m}$ (4k) pixel pitch, 100% fill factor
- High or low speed (40 or 80 MHz)
- Up to 68 KHz line rates
- Dynamic range up to 1400 : 1
- Data transmission up to 100m
- $\pm 50\mu\text{m}$ x, y sensor alignment
- RoHS and CE compliant
- Easy-to-use graphical user interface
- Serial interface (ASCII, 9600 baud, adjustable to 19200, 57600, 115200), through virtual serial port through Ethernet
- Programmable gain, offset, exposure time and line rate, trigger mode, test pattern output, and camera diagnostics
- Tall pixel, high sensitivity, or low sensitivity mode available.
- Flat-field correction – minimizes lens vignetting, non-uniform lighting, and sensor FPN and PRNU.

Description and Applications

The Spyder3 GEV is also DALSA's first dual line scan camera. When operating in high sensitivity (dual line scan) mode, the Spyder3 GEV camera has 3x the responsivity of DALSA's Spyder 2 line scan camera. The GigE Vision interface eliminates the need for a frame grabber, resulting in significant system cost savings.

The Spyder3 GEV camera is ideal for:

- FPD inspection
- Pick and place
- Container inspection
- Wood/tile/steel inspection
- 100% print inspection (lottery tickets, stamps, bank notes, paychecks)
- Postal sorting
- Glass bottle inspection
- Industrial metrology
- Food inspection
- Web inspection

Models

The Spyder3 GEV camera is available in the following configurations:

Table 1: Spyder3 GigE Vision Camera Models Overview

Model Number	Description
SG-11-01K80-00-R	1k resolution, 2 sensor taps, 80MHz data rate, RoHS compliant.
SG-11-02K80-00-R	2k resolution, 2 sensor taps, 80MHz data rate, RoHS compliant.
SG-11-01K40-00-R	1k resolution, 1 sensor tap, 40MHz data rate, RoHS compliant.
SG-11-02K40-00-R	2k resolution, 1 sensor tap, 40MHz data rate, RoHS compliant.
SG-11-04k80-00-R	4k resolution, 2 sensor taps, 80MHz data rate, RoHS compliant.

1.2 Camera Performance Specifications

Table 2: Spyder3 GigE Vision Camera Performance Specifications

Feature / Specification	1k	2k	4k
Imager Format	dual line scan	dual line scan	dual line scan
Resolution	1024 pixels	2048 pixels	4096 pixels
Pixel Fill Factor	100 %	100 %	100 %
Pixel Size	14 x 14 μm	14 x 14 μm	10 x 10 μm
Output Format (# of taps)	1 or 2 depending on model	1 or 2 depending on model	2
Sensitivity Mode	High, low, or tall pixel	High, low, or tall pixel	High, low, or tall pixel
Antiblooming	100x	100x	100x
Gain Range	-10 to 10 dB	-10 to 10 dB	-10 to 10 dB
Optical Interface			
Back Focal Distance	M42x1 6.56±0.25 mm Lens mount adapters are available. Contact Sales for more information.		
Sensor Alignment	x ±50 μm y ±50 μm z ±0.25 mm Yz ±0.2°		
Mechanical Interface	1k and 2k		4k
Camera Size	72(h) x 60(l) x 50(w) mm		65(h) x 58(l) x 85(w) mm
Mass	< 300 g		
Connectors	power connector 6 pin male Hirose GigE connector RJ45 GPI/O connector High density 15-pin dsub		
Electrical Interface			
Input Voltage	+12 to +15 volts		
Power Dissipation	< 9 W		< 9 W (4k)
Operating Temperature	0 to 50 °C		
Bit Width	8 or 12 bit, user selectable		
Output Data Configuration	GigE		
Speed	1k	2k	4k
Minimum Internal Line Rate	300 Hz	300 Hz	300 Hz
Maximum Line Rate			
80 MHz model	68 kHz	36 kHz	18.5 kHz
40 MHz model	36	18.5	NA

Feature / Specification	1k	2k	4k
Data Rate	40 or 80 MHz, model dependent	40 or 80 MHz, model dependent	80 MHz

Table 3: Camera Operating Specifications

Specifications	Unit	-10 dB			0 dB			+10 dB		
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max
Broadband responsivity	DN/(nJ/cm ²)									
1k and 2k Dual line			652.8			2064			6528	
1k and 2k Single line			326.4			992			3264	
4k Dual line			431			1363				
4k Single line			216			682				
Random noise rms	DN									
1k and 2k			3	6.5		9.2	20.5		30	65
4k						10	24			
Dynamic range	DN:DN									
1k and 2k Dual line		500:1	1400:1		203:1	324:1		59:1	108:1	
1k and 2k Single line		500:1	1400:1		203:1	324:1		59:1	108:1	
4k Dual and Single			1225:1			387:1				
FPN global	DN p-p									
Uncorrected				52.8			169.6			536
Corrected				32			32			64
PRNU ECD										
Uncorrected local	%			8.5			8.5			11.5
Uncorrected global	%			10			10			10
Corrected local	DN p-p			80			80			95
Corrected global	DN p-p			80			80			95
4k Dual and Single										
Corrected local	DN p-p			32			32			
Corrected global	DN p-p			80			80			
Uncorrected local	%			9.5			9.5			
Uncorrected global	%			20			20			
PRNU ECE										
Uncorrected local	%			8.5			12			37
Uncorrected global	%			10			12			37
Corrected local	DN p-p			80			237			752
Corrected global	DN p-p			80			208			752
4k Dual and Single										
Corrected local	DN p-p			237			237			
Corrected global	DN p-p			237			237			
Uncorrected local	%			9.5			9.5			
Uncorrected global	%			20			20			
SEE (calculated)	nJ/cm ²									
1k and 2k Dual line			6.35			1.92			0.61	
1k and 2k Single line			12.2			4.0			1.2	
4k Dual line			9.2			2.9				
4k Single line			18.0			5.7				
NEE (calculated)	pJ/cm ²									

Dual line		4.6	4.5	4.6
Single line		9.2	9.3	9.2
4k Dual line		7.0	8.1	
4k Single line		14.0	16.1	
Saturation output amplitude	DN		3968 ± 80	
DC offset	DN	96	160	336

Test conditions unless otherwise noted:

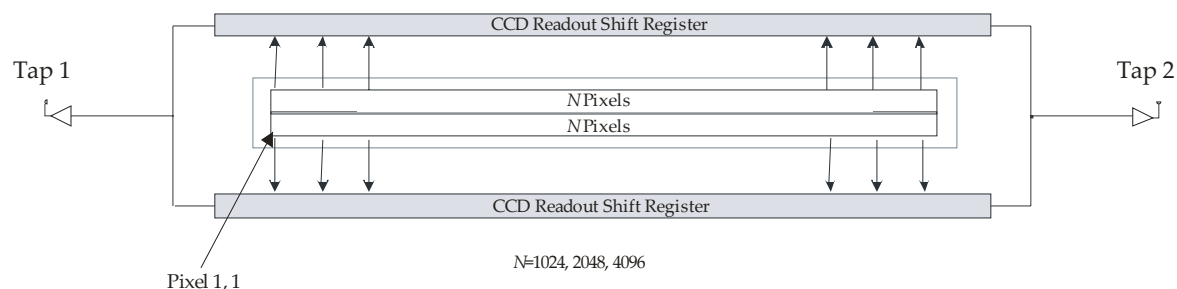
- 12-bit values, Flat Field Correction (FFC) enabled.
- CCD Pixel Rate: 40 MHz per sensor tap
- Line Rate: 5000 Hz
- Nominal Gain setting unless otherwise specified
- Light Source: Broadband Quartz Halogen, 3250k, with 750 nm highpass filter installed
- Ambient test temperature 25 °C
- Unless specified, all values are referenced at 12 bit
- Exposure mode disabled.
- Unless specified, dual line mode.

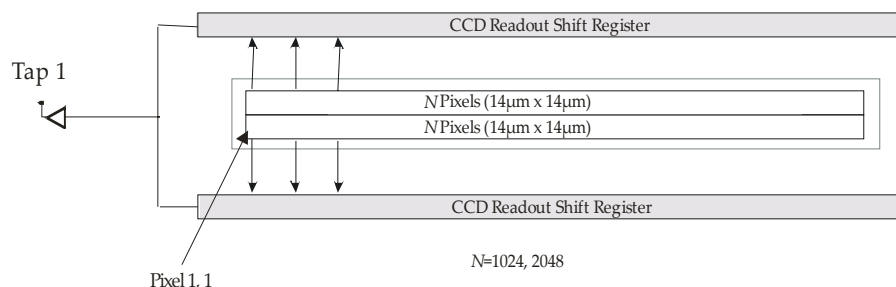
Notes

1. PRNU measured at 50% SAT.

1.3 Image Sensor

The camera uses DALSA's dual line scan sensor. The camera can be configured to read out in either high or low sensitivity mode, tall pixel mode, and forward or reverse shift direction.

Figure 1: 2 Tap Sensor Block Diagram**Figure 2: 1 Tap Sensor Block Diagram (1k and 2k only)**



Sensitivity Mode and Pixel Readout

The camera has the option to operate in either high sensitivity or low sensitivity mode or in tall pixel mode.

When in high sensitivity mode, the camera uses both line scan sensors and its responsivity increases accordingly. When in low sensitivity mode, the camera uses the bottom sensor. When operating in tall pixel mode, the camera operates using both sensors, creating a $28\mu\text{m} \times 14\mu\text{m}$ pixel.

The sensitivity mode is software controlled through QuickCam GEV, through the GenICam feature **SensitivityMode**.

Figure 3: High Sensitivity Mode

In high sensitivity mode, the camera uses either a $14\mu\text{m} \times 14\mu\text{m}$ pixel (1k and 2k models) or a $10\mu\text{m} \times 10\mu\text{m}$ pixel (4k model) and captures the same image twice, resulting in a brighter image.

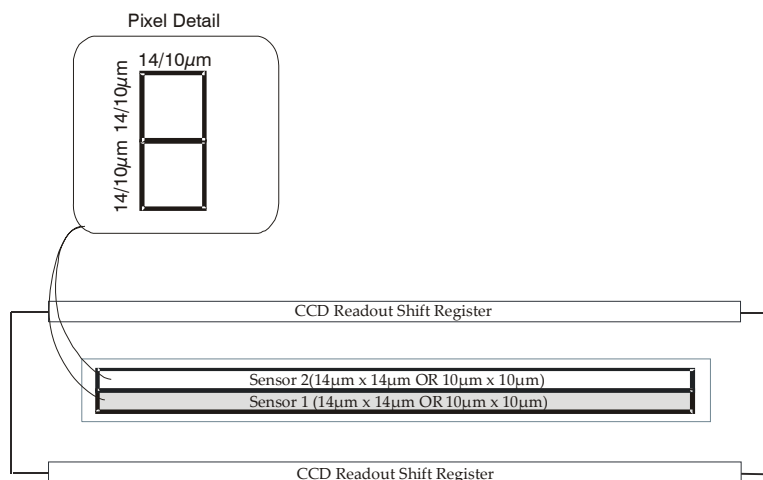
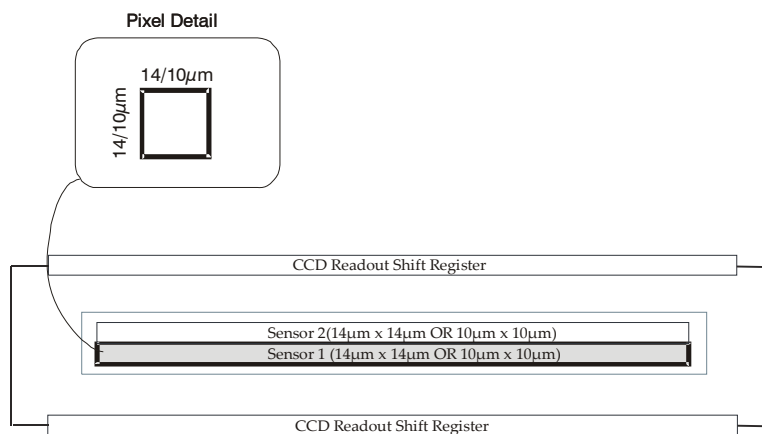
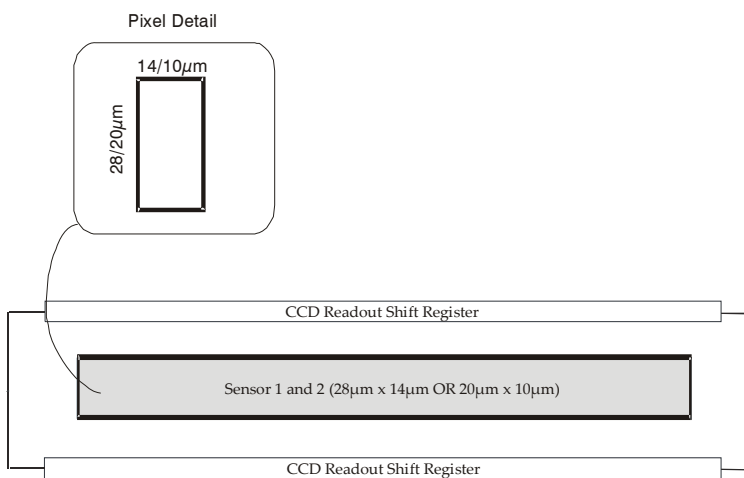


Figure 4: Low Sensitivity Mode

In low sensitivity mode, the camera uses either a $14\mu\text{m} \times 14\mu\text{m}$ pixel (1k and 2k models) or a $10\mu\text{m} \times 10\mu\text{m}$ pixel (4k model) and captures the image using one sensor (Sensor 1).

**Figure 5: Tall Pixel Mode**

In tall pixel mode, the camera uses a $28\mu\text{m} \times 14\mu\text{m}$ pixel (1k and 2k) or a $20\mu\text{m} \times 10\mu\text{m}$ pixel (4k model) and captures an image two times taller than in high or low sensitivity modes, resulting in a taller image.



1.4 Responsivity

Figure 6: Spyder3 GigE Vision 1k and 2k Responsivity

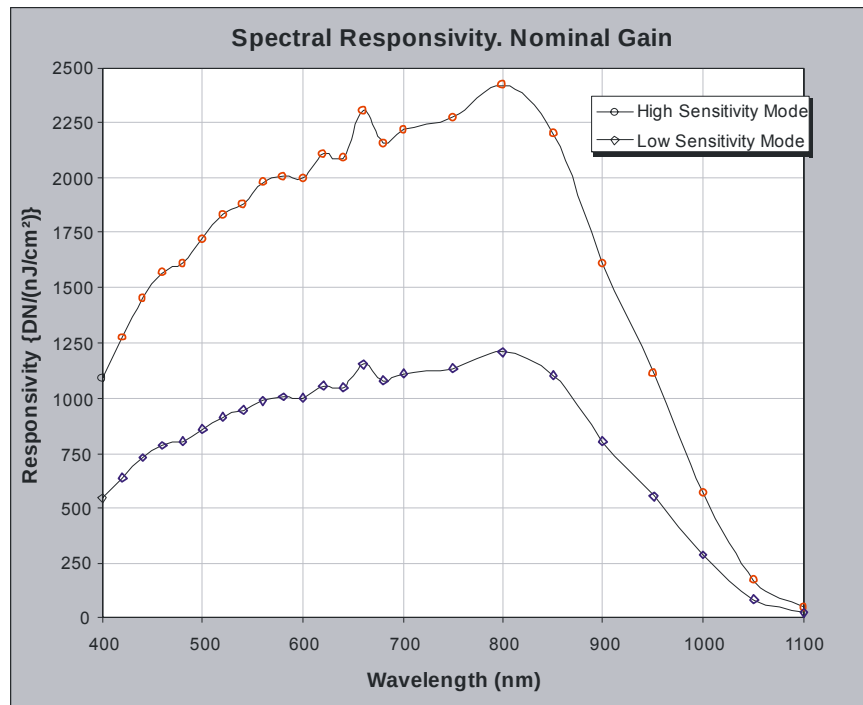
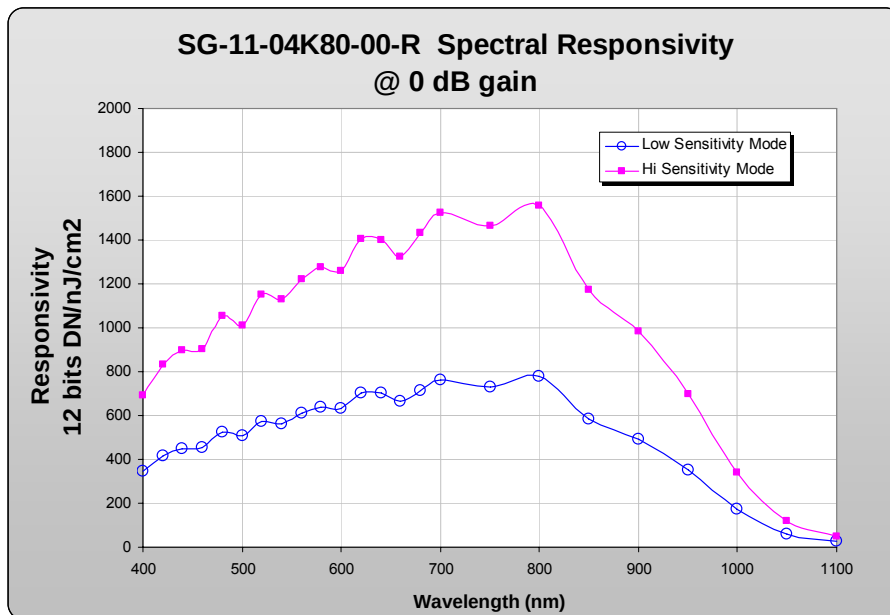


Figure 7: Spyder3 GigE Vision 4k Responsivity



Refer to section 1.3 Image Sensor for a description of high and low sensitivity modes.

1.5 Supported Industry Standards



Spyder GEV cameras are 100% compliant with the GigE Vision 1.0 specification. This specification defines the communication interface protocol used by GigE Vision devices. For more information on these requirements refer to the following site:
<http://www.machinevisiononline.org/public/articles/details.cfm?id=2761>



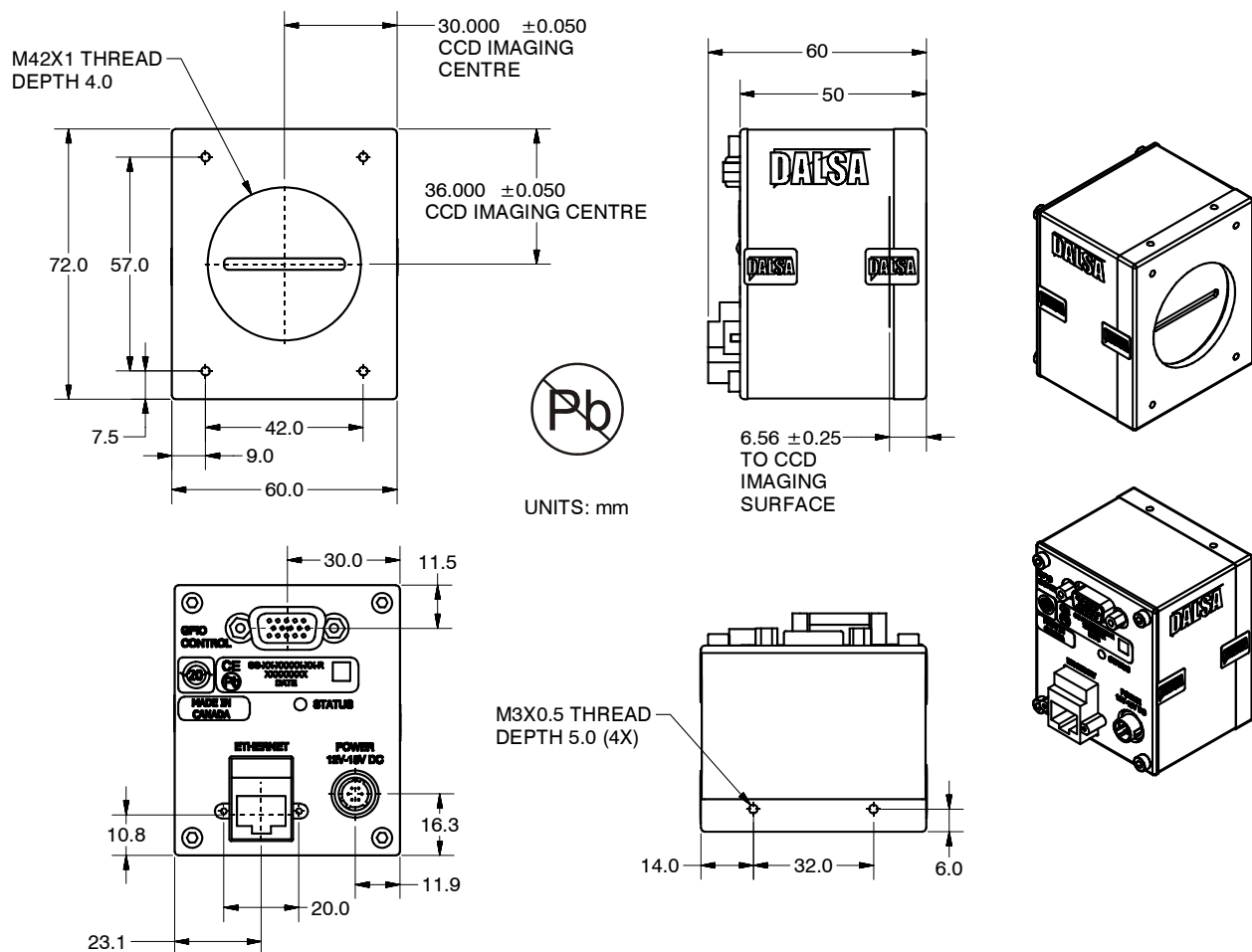
Spyder GEV cameras implement a superset of the GenICam™ specification which defines device capabilities. This description takes the form of an XML device description file respecting the syntax defined by the GenApi module of the GenICam™ specification. For more information on these requirements refer to the following site: www.genicam.org.

2

Mechanicals and Optics

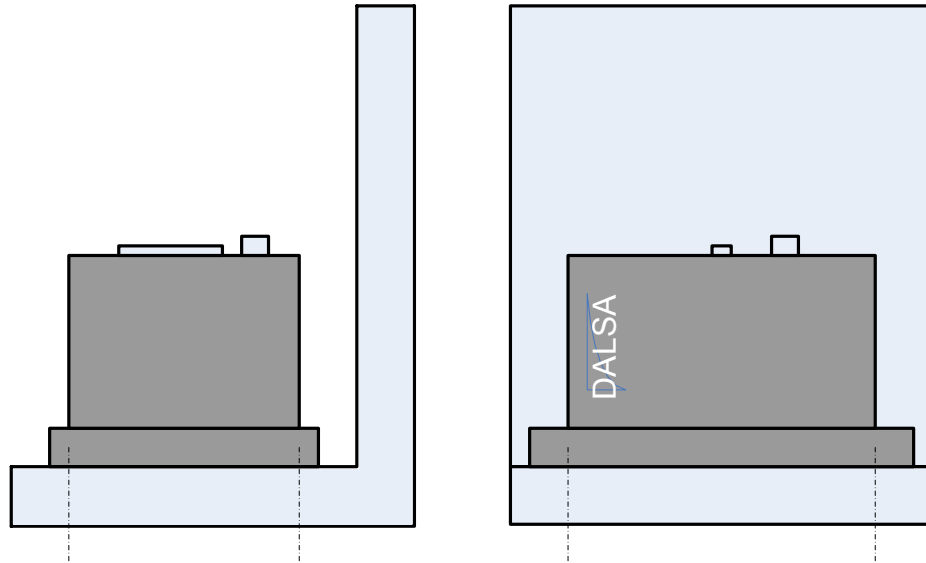
2.1 Mechanical Interface

Figure 8: Spyder3 1k and 2k GigE Vision Camera Mechanical Dimensions



2.2 Mounting

DALSA recommends that you allow the heat generated by the camera to move away from the camera. One way to do this is by mounting the camera correctly, as shown:



2.3 Optical Interface

Illumination

The amount and wavelengths of light required to capture useful images depend on the particular application. Factors include the nature, speed, and spectral characteristics of objects being imaged, exposure times, light source characteristics, environmental and acquisition system specifics, and more.

DALSA's Web site, <http://mv.dalsa.com/>, provides an introduction to this potentially complicated issue. See "Radiometry and Photo Responsivity" and "Sensitivities in Photometric Units" in the CCD Technology Primer found under the Application Notes and Technology Primers section of the Knowledge Center (www.dalsa.com/mv/knowledge).

It is often more important to consider exposure than illumination. The total amount of energy (which is related to the total number of photons reaching the sensor) is more important than the rate at which it arrives. For example, $5\mu\text{J}/\text{cm}^2$ can be achieved by exposing $5\text{mW}/\text{cm}^2$ for 1ms just the same as exposing an intensity of $5\text{W}/\text{cm}^2$ for $1\mu\text{s}$.

Light Sources

Keep these guidelines in mind when setting up your light source:

- LED light sources are relatively inexpensive, provide a uniform field, and longer life span compared to other light sources. However, they also require a camera with excellent sensitivity, such as the Spyder3 GEV camera.
- Halogen light sources generally provide very little blue relative to infrared light (IR).
- Fiber-optic light distribution systems generally transmit very little blue relative to IR.
- Some light sources age; over their life span they produce less light. This aging may not be uniform—a light source may produce progressively less light in some areas of the spectrum but not others.

Filters

CCD cameras are extremely responsive to infrared (IR) wavelengths of light. To prevent infrared from distorting the images you scan, use a “hot mirror” or IR cutoff filter that transmits visible wavelengths but does not transmit wavelengths over 750nm. Examples are the Schneider Optics™ B+W 489, which includes a mounting ring, the CORION™ LS-750, which does not include a mounting ring, and the CORION™ HR-750 series hot mirror.

2.4 Electrical Interface

The Spyder3 GEV cameras have been designed for EMC compliance. The test setup has been verified to the following EMC standards:

- CISPR-11:2004
- EN 55011:2003
- EN 61326:2002

To achieve EMC compliance, follow these specific guidelines:

- Ensure that all cable shields have 360° electrical connection to the connector.
- Fasten and secure all connectors.

The EMC compliance is achieved with the use of shielded CAT5e or CAT6 Ethernet cables

3

Setting Up the Camera

3.1 Installation Overview

1. Install Ethernet card

Following the manufacturer's instruction, install an Ethernet card. For gigabit performance, you must install an intel PRO/1000 Ethernet card.

Note: Do not install the manufacturer's driver. You will install the appropriate QuickCam driver in a later step.

2. Install QuickCam GUI

Insert the Spyder3 GigE Vision CD into your CD-ROM drive and follow the onscreen instructions to install the QuickCam GUI.

3. Install QuickCam driver

There is an overview of the available drivers in Section 2.3, below.

Open the Driver Installation Tool. On the Windows task bar, click Start > Programs > DALSA QuickCam GEV > Tools > Launch EbDriver Tool.exe

From the Driver Installation Tool window, select the network adapter that is connected to the camera and click the Configure... button.

From the Driver selection window, select your preferred driver.

For SG-11 cameras using the Intel PRO/1000 NIC adapter, choose the eBus Optimal Driver.

If you are not using an Intel PRO/1000 adapter, choose the eBus Universal Driver and use a network driver.

4. Connect GPIO cable

If using an external sync, external direction control, or any other external signals, connect the GPIO cable to the back of the camera.

5. Connect Ethernet cable

Connect a Cat 5 or Cat 6 cable from the camera to the computer ethernet jack.

6. Connect power cable

Connect a power cable from the camera to a +12V to +15V power supply.

7. Open QuickCam

On the Windows task bar, click Start > Programs > DALSA QuickCam GEV > DALSA QuickCam GEV.

8. Confirm or enter IP address

In the Set Camera's IP Address dialog box, confirm or enter the camera's IP address. Click OK.

9. Start acquiring images

On the QuickCam toolbar, click the Continuous Grab icon (). The image should be visible in the Image Output window.

Note: Refer to the following sections for details on equipment recommendations and camera connector information.

3.2 Equipment Recommendations

PC Requirements

To achieve best performance, the following minimum requirements are recommended:

- Processor: AMD Athlon XP 2000+ or Intel P4 2.0GHz
- Memory: 512MB DDR-RAM PC2700
- Motherboard: Mid-end without embedded graphic card. Avoid using onboard video cards as they may compete with other components for shared memory.
- VGA card: Nvidia GForce 2 or better (ATI not recommended). Some ATI video cards will use a high amount of the PCI bandwidth and compete with other components, such as the GigE network card. This may lower the expected data rate of applications.
- GigE network adapter (either PCI card or LOM): For high performance, you must use a Intel PRO/1000 MT adapter
- Operating system: Windows 2000 (SP4), Windows XP Professional

Network Adapter Requirements

The Spyder3 GEV camera works only with network adapters based on the Intel 82546, 82541, and 82540 network chips. The driver will also function with adapters based on the Intel 82544 chip, but these are not recommended due to bugs in the chip that can cause control packets to be lost if sent while data is streaming.

Contact DALSA for information on how to use these network chips with the DALSA QuickCam High-Performance IP Device Driver.

Ethernet Switch Requirements

When you require more than one device on the same network or a camera-to-PC separation of more than 100 metres, you can use an Ethernet switch. Since the Spyder3 GEV camera complies with the Internet Protocol, the camera should work with all standard Ethernet switches. However, switches offer a range of functions and performance grades, so care must be taken to choose the right switch for a particular application. The following switches are expected to work with the camera:

3.3 Drivers: Overview

Note: Documentation containing more information and instructions on installing the drivers can be found at <C:\DALSA\Spyder3\Ethernet Bus\Documentation\index.html>.

eBus Optimal Driver

The eBus Optimal Driver is our recommended driver for applications demanding high bandwidth. The driver is a purpose-built replacement for the regular driver that comes with Intel PRO/1000 card or 825xx chip. Designed to maximize throughput and minimize CPU usage, this driver is ideal for high-bandwidth applications that need virtually all the CPU for other application tasks. (It also supports corporate network connectivity.)

Efficiency ★★★★★

Usage High bandwidth with CPU-intensive applications

Limitations Requires NIC from Intel's family of PRO/1000 cards and 825xx chips

eBus Universal Driver

The eBus Universal Driver replaces the CPU intensive Windows network stack. It works with almost any NIC because it works in conjunction with your NIC's regular driver. It supports corporate network connectivity.

Efficiency ★★★★★☆

Usage High bandwidth application that can tolerate some sharing of the CPU capacity

High Performance Driver Mode

If you are upgrading your existing systems, have an existing project, and you don't require a GigE Vision compliant connection, then we recommend that you continue to use your current driver.

In high-performance mode, the Spyder3 GEV works with the High-Performance IP Device Driver to transfer data between cameras and PCs with very low, predictable latency at rates of up to 1 Gb/s (100 MB/s). The video data is streamed directly into PC memory using almost no PC CPU resources. This leaves the CPU free to process applications.

Efficiency ★★★★★

Usage Existing projects requiring high-bandwidth

Limitations Requires NIC from Intel's family of PRO/1000 cards and 825xx chips

To achieve this performance level, PCs must be equipped with a GigE network interface (also referred to as a network adapter) based on Intel's 82540 chip. Many motherboard manufacturers have designed this chip directly into their board in "LAN on the motherboard (LOM)" implementations. Alternately, an Intel 82540-based network adapter, also known as a network interface card, can be slotted into a PC.

The High-Performance IP device driver is very efficient but disregards regular Internet traffic. Because of this, it doesn't support corporate network connectivity.

Standard Driver Mode

In standard mode, the Spyder3 GEV operates with any vendor's Ethernet network adapter. The driver shipped with the adapter transfers the data to the Windows network stack, which handles IP communications tasks.

Efficiency ★☆☆☆☆

Usage Low-bandwidth application or temporary

Standard mode is recommended for applications where flexibility is more important than performance. The Windows network stack uses significant levels of CPU processing power to transfer data to memory, which can result in lost packets, severely degrading performance.

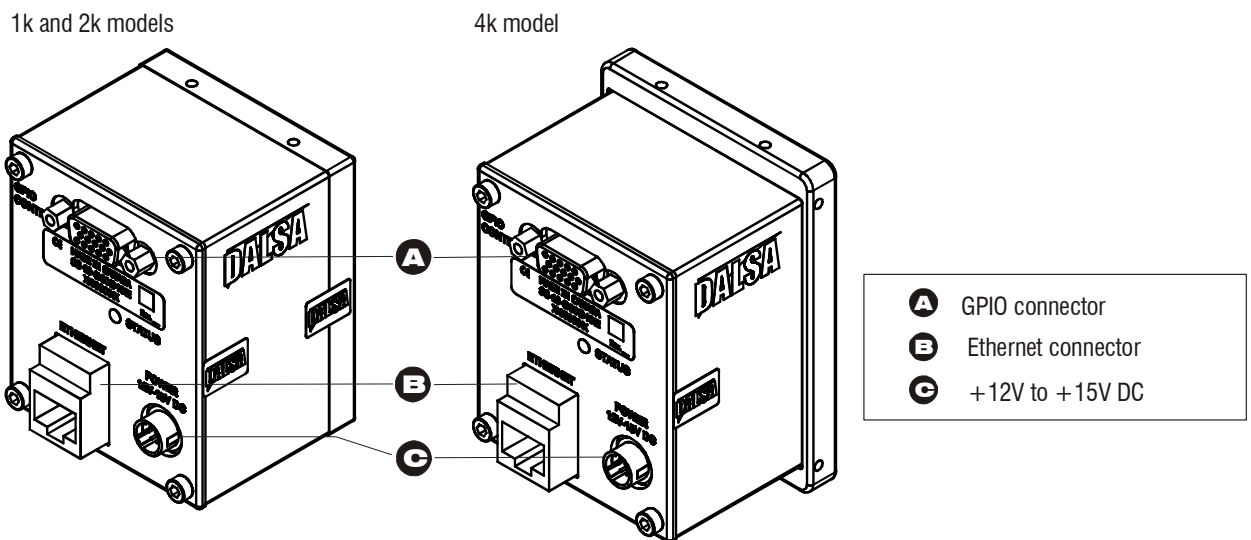
Standard mode is thus suitable for applications that require bandwidths of only 100 Mb/s or less. If this mode is used with bandwidths of 1 Gb/s, application performance will greatly degrade when CPU usage hits 100%. Additionally, at high rates like these, insufficient CPU resources may be available to process or even display images.

3.4 Camera Connectors

This camera uses the following connectors:

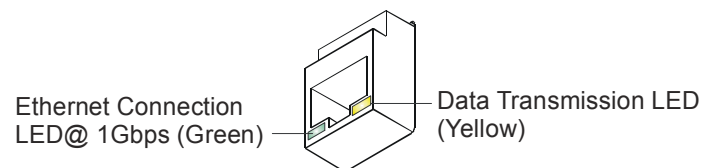
- An RJ-45 connector for Gigabit Ethernet signals, data signals, and serial communications. Refer to section Ethernet Connector for details.
- One 6-pin Hirose connector for power. Refer to section Power Connector for details.
- One 15-pin general purpose input/output (GPIO) connector. Refer to section GPIO Connector for details.

Figure 10: Spyder3 GEV Input and Output Connectors



WARNING: It is extremely important that you apply the appropriate voltages to your camera. Incorrect voltages may damage the camera.

Ethernet Connector



Ethernet Connection LED

Steady green indicated that an Ethernet connection is successfully established at 1Gbps.

Data Transmission LED

Steady yellow indicates that the camera is ready for data transmission. Flashing yellow indicates that the camera is transmitting or receiving data.

EMC Compliance

In order to achieve EMC compliance, the Spyder3 camera requires the use of shielded CAT5e or CAT6 Ethernet cables.

Power Connector

Figure 11: Hirose 6-pin Circular Male—Power Connector

Hirose 6-pin Circular Male



Table 4: Hirose Pin Description

Pin	Description	Pin	Description
1	Min +12 to Max +15V	4	GND
2	Min +12 to Max +15V	5	GND
3	Min +12 to Max +15V	6	GND

The camera requires a single voltage input (+12 to +15V). The camera meets all performance specifications using standard switching power supplies, although well-regulated linear supplies provide optimum performance.



WARNING: When setting up the camera's power supplies follow these guidelines:

- Apply the appropriate voltages.
- Protect the camera with a **fast-blow fuse** between power supply and camera.
- Do not use the shield on a multi-conductor cable for ground.
- Keep leads as short as possible in order to reduce voltage drop.
- Use high-quality **linear** supplies in order to minimize noise.

Note: If your power supply does not meet these requirements, then camera performance specifications are not guaranteed.

DALSA offers a power supply with an attached 6' power cable that meets the Spyder3 GEV camera's requirements, but it should not be considered the only choice. Many high quality supplies are available from other vendors.

Visit the www.dalsa.com Web site for a list of companies that make power supplies that meet the camera's requirements. The companies listed should not be considered the only choices.

GPIO Connector

The GPIO connector is used to receive or control external signals. For example, the GPIO connector can be used to receive EXSYNC, PRIN (pixel reset), and direction signals.

Figure 12: GPIO Connector and Pin Numbers

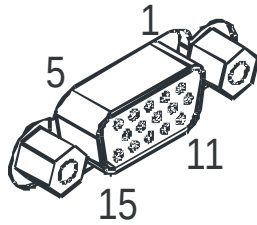


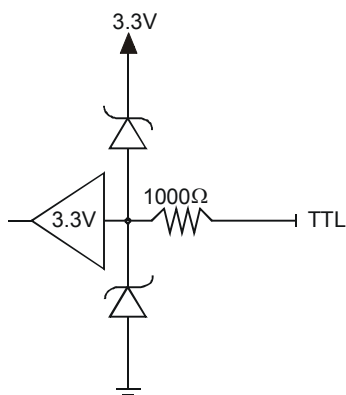
Table 5: GPIO Connector Pinout

Pin	Signal	Description	GenICam Default
1	INPUT_0+	LVDS/TTL format (positive)	EXSYNC +
2	INPUT_0-	LVDS (negative)	EXSYNC -
3	INPUT_1+	LVDS/TTL format (positive)	FrameTrig +
4	INPUT_1-	LVDS (negative)	FrameTrig -
5	GND		
6	INPUT_2+	LVDS/TTL format (positive)	Direction +
7	INPUT_2-	LVDS (negative)	Direction -
8	INPUT_3	TTL auxiliary input	
9	OUTPUT_3	TTL auxiliary output	
10	OUTPUT_2+	LVDS/TTL auxiliary output	
11	OUTPUT_0+	LVDS/TTL auxiliary output	
12	OUTPUT_0-	LVDS (negative)	
13	OUTPUT_1+	LVDS/TTL auxiliary output	
14	OUTPUT_1-	LVDS (negative)	
15	OUTPUT_2-	LVDS (negative)	

A schematic of the TTL input circuitry is shown in Figure 13: TTL Input Schematic. The input signals are fed into the engine from external sources via the GPIO connector.

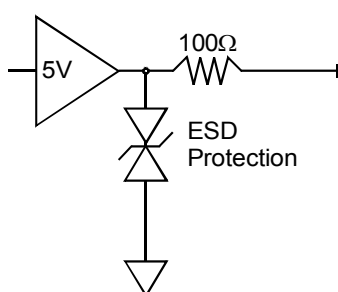
TTL Inputs and Outputs

Figure 13: TTL Input Schematic



- Termination: 1000 Ω series
- Input current: minimum 0 nA; maximum 2 mA
- Input voltage: maximum of low 0.66 V; minimum of high 2.6 V
- TTL inputs are maximum 5V and 3.3V logic tolerant

Figure 14: TTL Output Schematic



- Termination: 100 Ω series
- Output current: sink 50 mA; source 50 mA
- Output voltage: maximum of low 0.55 V @ 32mA; minimum of high 3.8 V @ 32mA.

LVDS Inputs and Outputs (LVDS compliant)

Figure 15: LVDS Input

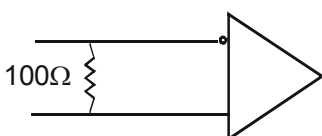
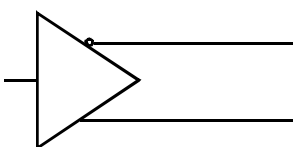


Figure 16: LVDS Output



GPIO Isolation

All of the GPIOs are isolated from the rest of the camera and the camera case. They are not isolated with respect to each other and share a common return (ground) through pin 5 of the GPIO connector.

Note: The shell connection of the GPIO connector is not isolated and it should not be used as a return (ground) for the GPIO signals. The shell connection is attached to the camera case.

Programming the GPIO Connector

The GPIO connector is programmed through the QuickCam application or through the QuickCam SDK.

After you have installed the QuickCam program, refer to the QuickCam User's Manual or the QuickCam help topic, GPIO Control, for more information on programming this connector.

3.5 Camera LED

The camera is equipped with a red/green LED used to display the status of the camera's operation. The table below summarizes the operating states of the camera and the corresponding LED states.

When more than one condition is active, the LED indicates the condition with the highest priority. Error and warning states are accompanied by corresponding messages that further describe the current camera status.

Table 6: Diagnostic LED

Priority	Color of Status LED	Meaning
1	Flashing Red	Fatal Error. For example, camera temperature is too high and camera thermal shutdown has occurred.
2	Flashing Green	Camera initialization or executing a long command (e.g., flat field correction commands ccp or ccf).
3	Solid Green	Camera is operational and functioning correctly.

4

EMC Declaration

Dalsa's SG-11 cameras meet the requirements outlined below which satisfy the EMC requirements for CE marking, the FCC Part 15 Class A requirements, and the Industry Canada requirements.

Model SG-11-04K80
The CE Mark Evaluation of the Dalsa SG-11 Camera, which is manufactured by Dalsa Inc., meets the following requirements:
EN 55022 , EN 55011 , and FCC Part 15 Class A Emissions Requirements EN 61326-1 and EN 55024 Immunity to Disturbances
Models SG-11-02k 40 and 80, SG-11-01k 40 and 80
The CE Mark, FCC Part 15, and Industry Canada ICES-003 Evaluation of the DALSA Spyder GigE Camera meets the following requirements:
EN 55022 Class A, and EN 61326 Emissions Requirements EN 55024, and EN 61326 Immunity to Disturbances

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's own expense.

Changes or modifications not expressly approved by DALSA could void the user's authority to operate the equipment.

Name and Signature of authorized person

Hank Helmond
Quality Manager, DALSA Corp.



5

Controlling the Camera

To control the camera, you have a choice of using the following:

- GenICam Interface. (See below).
- The DALSA QuickCam graphical user interface (GUI). QuickCam provides a quick and easy way to start imaging with the camera. All camera functionality can be controlled with the QuickCam application. QuickCam is available on the Spyder3 GigE Vision Color CD. Online Help is available through the QuickCam GUI. The QuickCam GUI can also be used to send ASCII commands to the camera.
- The DALSA QuickCam SDK. All the functionality of the QuickCam application is also available in custom built applications created using the Camera Interface Application SDK. You can also use the SDK to create a new, camera specific, interface. The SDK is available on the Spyder3 GigE Vision Color CD.
- ASCII commands. All of the camera's functionality is accessible through the camera's serial interface. A list of the available ASCII Commands can be found in the Appendix.

5.1 GenICam Interface

GenICam Environment

Spyder GEV cameras implement the GenICam™ specification, which defines the device capabilities.

The GenICam XML device description file is embedded within the Spyder firmware allowing GenICam applications to recognize the Spyder GEV cameras' capabilities immediately after connection. For more information about the GenApi module of the GenICam™ specification see www.genicam.org.

5.2 GenICam Commands

In the camera	ASII	Description
AcquisitionLineRateAbs	ssf	sets the camera's line rate in Hz. Camera must be operating in (DALSA) exposure mode 2 or 7.

		Min 300 Hz, Max 18500 Hz
BinningHorizontal	sbh	set binning horizontal Min 1, Max 2
BlackLevelRaw [BlackLevelSelector]	sao	set analog offset ti 0-1:0-255
BlackLevelSelector		Black level tap selector
CalculateAnalogCameraGain [CameraGainAlgorithmSelector]	cag	Calibrates the analog gain 1 and 2k models only
CalculateDigitalCameraGain		Calibrates the digital gain so that the average pixel in the ROI is equal to the specified target value (i.e. CalculateCameraGainTargetValue).
CalculateDigitalCameraGainTarget		The target of the digital gain calibration algorithm
CalculatePRNUAlgorithmTargetValue	cpa	Performs PRNU calibration according to the selected algorithm selector (1-3) Min 1024, Max 4055
CalculatePRNUCoefficients		Calculates the PRNU coefficients using the CalculatePRNUAlgorithmTargetValue
CalculateCameraGainTargetValue	cag	The target of the analog gain calibration algorithm Min 1024, Max 4095 1 and 2k models only
CalculatePRNUAlgorithm		
CameraGainAlgorithmSelector		
CameraTemperatureAbs	vt	verify temperature. Camera temperature.
CameraVoltageAbs	vv	verify voltage. Camera voltage.
CorrectionCalibrateFPN	ccf	NOTE: this feature will be available soon. Performs FPN correction and eliminates FPN noise by subtracting away individual pixel dark current.
CorrectionCalibratePRNU	ccp	NOTE: this feature will be available soon. Performs PRNU correction and eliminates the difference in responsivity between the most and least sensitive pixel creating a uniform response to light.
DALSAExposureMode	sem	Exposure mode used in DALSA cameras (2-8)
DeviceModelName	gcm	
DALSAImageSelector	svm	set video mode. Test image selection
DeviceReset	rc	NOTE: this feature will be available soon. reset camera
DeviceSerialNumber	gcs	get camera serial number. Returns the camera's serial number.
DigitalGainRaw [GainSelector]	ssg	set system gain to 0-1:0-65535
DigitalOffsetRaw [DigitalOffsetSelector]	sdo	set digital offset 0-2048
DigitalOffsetSelector		DigitalOffsetSelector = {All = 0, Tap1 = 1, Tap2 = 2}
EnablePixelCoefficients	epc	Enables and disables FPN and PRNU coefficients.
EndOfLineSequence	els	end of line sequence
ExposureTimeAbs	set	Set exposure time in uSec (exposure mode must be 2,6,8) Min 3, Max 3300
GainAbs [GainSelector]	sag	Analog gain 1 and 2k models only
GainSelector		The tap selector for the gain.
GPIOInput [GPIOSelector]	sgi	set GPIO input. Sets GPIO input signals.
GPIOOutput	sgo	set GPIO output. Sets GPIO output signals.

[GPIOSelector]		
GPIOSelector		GPIO selector for sgi and sgo.
Height		This feature represents the actual image height expelled by the camera (in pixels). Min 1, Max 16383
LedStatus	glS	get status led. Returns the current state of the cameras LED where: 1: Red, 2: Green, 5: Blinking green, 6: Blinking red
LoadPixelCoefficients	lpc	Load PRNU and FPN coefficients from cameras non-volatile memory.
LowerThresholdLimitRaw	slt	Set lower threshold Min 0, Max 4095
PixelFormat	sdm	This feature indicates the format of the pixel to use during the acquisition.
PixelSetSelector		Selector for the FFC Coefficient Set
ReadoutMode	srM	set readout mode. Use this command to clear out dark current charge in the vertical transfer gates immediately before the sensor is read out.
ResetPixelCoefficients	rpc	reset pixel coeffs. Resets the pixel coefficients to 0.
RestoreFactorySettings	rfs	restore factory settings. Restores the cameras factory settings. FPN and PRNU coefficients reset to 0.
RestoreUserSettings	rus	restore user settings. Restores the camera's last saved user settings and FPN and PRNU coefficients.
SensitivityMode	ssm	Set sensitivity mode
SensorDigitizationTaps		This feature represents the number of digitized samples outputted simultaneously by the camera A/D conversion stage.
SensorShiftDirection	scd	CCD sensor shift direction. NOTE: only available when SensitivityMode is 1.
SensorWidth		This feature indicates the effective width of the sensor in pixels.
SubtractBackgroundRaw [SubtractBackgroundSelector]	ssb	Set Subtract Background 1-4096. Subtract the input value from the output signal. Min 0, Max 4095
SubtractBackgroundSelector		selector for SubtractBackground
TestImageSelector	svm	This feature selects the type of test image that is expelled by the camera.
UpdateGainReference	ugr	update gain reference. Changes 0dB gain to equal the current analog gain value set with the sag command.
UpperThresholdLimitRaw	sut	Set upper threshold Min 0, Max 4095
Width		This feature represents the actual image width expelled by the camera (in pixels). Min 8, Max 4096
WriteFPNCoefficients	wfc	Write FPN coefficients to cameras non-volatile memory.
WritePRNUCoefficients	wpc	Write PRNU coefficients to cameras non-volatile memory.
WriteUserSetting	wus	NOTE: this feature will be available soon. write user settings. Save user setting.

5.3 First Power Up Camera Settings

When the camera is powered up for the first time, it operates using the following factory settings:

- High sensitivity mode.
- Forward CCD shift direction.
- No binning.
- Exposure mode 7 (Programmable line rate & max exposure time).
- 5000 Hz line rate.
- Factory calibrated analog gain and offset.
- Analog gain enabled (1k and 2k use). (It is recommended that you use the system gain command with the 4k in order to maintain valid LUT calibration.)
- LUTs enabled (4k default), factory calibrated @ -10dB.
- Factory calibrated FPN and PRNU coefficients using the following process: line rate of 5000 Hz, analog gain calibrated to an average pixel value of 248 DN, fpn calibration, prnu calibration, 8 bit output, 9600 baud rate, exposure mode 2.

Notes: The FPN and PRNU coefficients are factory calibrated at a 5 kHz line rate and 0dB gain setting. While the factory setting baud rate is 9600, QuickCam sets the baud rate to 57600 at startup.

5.4 Output Format

Sensitivity Mode

Sets the camera's sensitivity mode. When using high sensitivity mode, the camera's responsivity increases. High sensitivity mode permits much greater scanning speeds in low light. It can also allow for reduced lighting levels.

SensitivityMode = {Low = 0, High = 1, TallPixel = 3}

- The **SensorShiftDirection** command is not available in low sensitivity mode or tall pixel mode.

CCD Shift Direction

When in high sensitivity mode, selects the forward or reverse CCD shift direction or external direction control. This accommodates object direction change on a web and allows you to mount the camera "upside down".

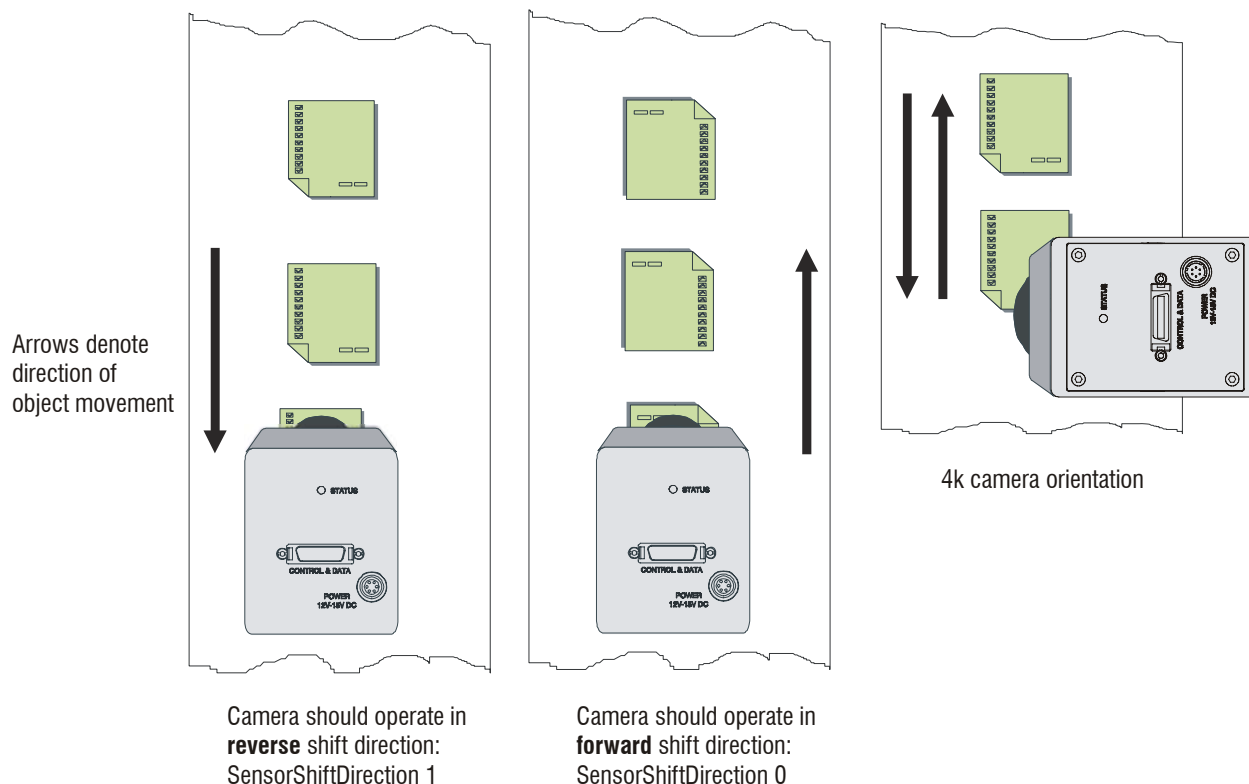
SensorShiftDirection = {ForwardDirection = 0, ReverseDirection = 1, ExternalControl = 2}

- Available in high sensitivity mode only.

Sensor Shift Direction

When in high sensitivity mode, you can select either forward or reverse CCD shift direction. Selectable direction accommodates object direction change on a web and allows you to mount the camera “upside down”.

Figure 17: Object Movement and Camera Direction Example using an Inverting Lens



Pixel Format

Selects the camera's bit depth.

PixelFormat = {Mono8, Mono12}

5.5 Timing: Exposure and Synchronization

Image exposures are initiated by an event. The trigger event is either the camera's programmable internal clock used in free running mode, an external input used for synchronizing exposures to external triggers, or a programmed function call message by the controlling computer. These triggering modes are described below.

Free running (trigger disabled): The camera free-running mode has a programmable internal timer for frame rate and a programmable exposure period. Frame rate is 0.1 fps to the maximum supported by the sensor. Exposures range from the sensor minimum to a maximum also dependent on the current frame rate. This always uses Synchronous mode where exposure is aligned to the sensor horizontal line timing.

External trigger: Exposures are controlled by an external trigger signal. External signals are isolated by an opto-coupler input with a time programmable debounce circuit. The following section provides information on external trigger timing.

Software trigger: An exposure trigger is sent as a control command via the network connection. Software triggers can not be considered time accurate due to network latency and sequential command jitter. But a software trigger is more responsive than calling a single-frame acquisition (Snap command) since the latter must validate the acquisition parameters and modify on-board buffer allocation if the buffer size has changed since the last acquisition.

Timing

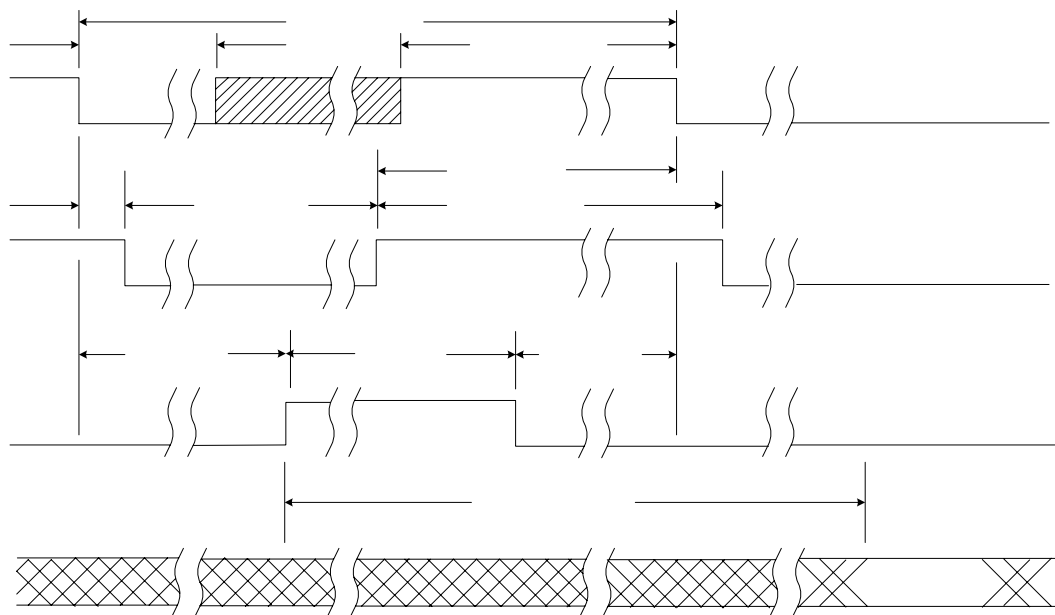


Table 7: Timing Parameter Table

	Units	Min.	Typ.	Max.	Notes
tLine_Period	μs	27.78		1000	1K 1 Tap
		14.71		1000	1K 2 Tap
		54.1		1000	2K 1 Tap

		27.78		1000	2K 2 Tap
		54.1		1000	4k 2 Tap
twSync	ns	100			
twSYNC_INT	ns	100 (3000*)			For exposure mode 4 this value needs to be >3000ns other wise >100ns
tPR	ns	0			
twPR_LOW	ns	3000			
twPR_HIGH	ns	3000			
tPR_INT	ns	3000			

Table 8: tReadout Values

tREADOUT		
Sensor Size	# Taps	Readout Time
1024	1	25600ns
1024	2	12800ns
2048	1	51200ns
2048	2	25600ns
4096	2	

Table 9: tOverhead Values

tOVERHEAD		
Sensor Size	# Taps	Readout Time
1024	1	725ns
1024	2	450ns
2048	1	1400ns
2048	2	725ns

Overhead Delay

Overhead_Delay can range from 5 to 6 μ s and depends on the internal operations of your computer.

Exposure Mode, Readout Mode, Line Rate and Exposure Time

Overview

You have a choice of operating in one of seven modes. The camera's line rate (synchronization) can be generated internally through the software command **AcquisitionLineRateAbs** or set externally with an EXSYNC signal, depending on your mode of operation.

To select how you want the camera's line rate to be generated:

1. You must first set the camera mode using the **DALSAExposureMode** command.
2. Next, if using mode 2, 6, 7, or 8 use the commands **AcquisitionLineRateAbs** and/or **ExposureTimeAbs** to set the line rate and exposure time.

1. Set the Exposure Mode

Sets the camera's exposure mode allowing you to control your sync, exposure time, and line rate generation.

DALSAExposureMode = {Mode = 2, Mode3 = 3, Mode4 = 4, Mode5 = 5, Mode6 = 6, Mode7 = 7 }

- Factory setting is mode 7.

Related Commands: **AcquisitionLineRateAbs**, **ExposureTimeAbs**

Table 10: Spyder3 GigE Vision Exposure Modes

Mode	Programmable Line Rate		Programmable Exposure Time		Description
	SYNC	PRIN	↓	↓	
2	Internal	Internal	Yes	Yes	Internal frame rate and exposure time. Exposure mode enabled (ECE).
3	External	Internal	No	No	Maximum exposure time. Exposure control disabled (ECD).
4	External	Internal	No	No	Smart EXSYNC. ECE.
5	External	External	No	No	External sync, external pixel reset. ECE.
6	External	Internal	No	Yes	Fixed integration time. ECE.
7	Internal	Internal	Yes	No	Internal line rate, maximum exposure time. ECD.
8	Internal	Internal	No	Yes	Maximum line rate for exposure time. ECE.

Note: When setting the camera to external signal modes, EXSYNC and/or PRIN must be supplied.

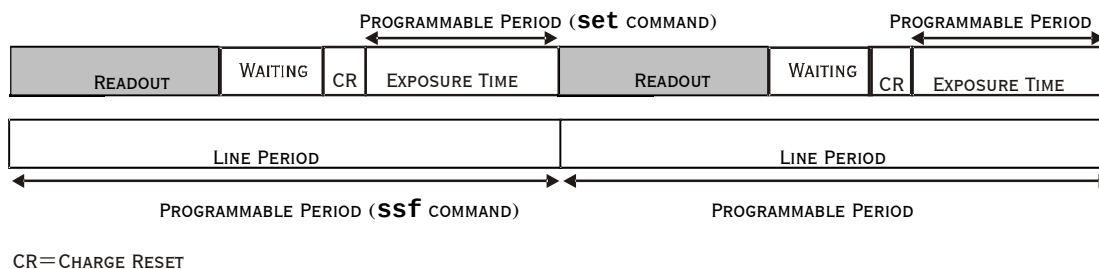
Exposure Modes in Detail

Mode 2: Internally Programmable Line Rate and Exposure Time (Factory Setting)

Mode 2 operates at a maximum line rate and exposure time.

- When setting the line rate (using the **AcquisitionLineRateAbs** command), exposure time will be reduced, if necessary, to accommodate the new line rate. The exposure time will always be set to the maximum time (line period – line transfer time – pixel reset time) for that line rate when a new line rate requiring reduced exposure time is entered.
- When setting the exposure time (using the **ExposureTimeAbs** command), line time will be increased, if necessary, to accommodate the exposure time. Under this condition, the line time will equal the exposure time + line transfer time.

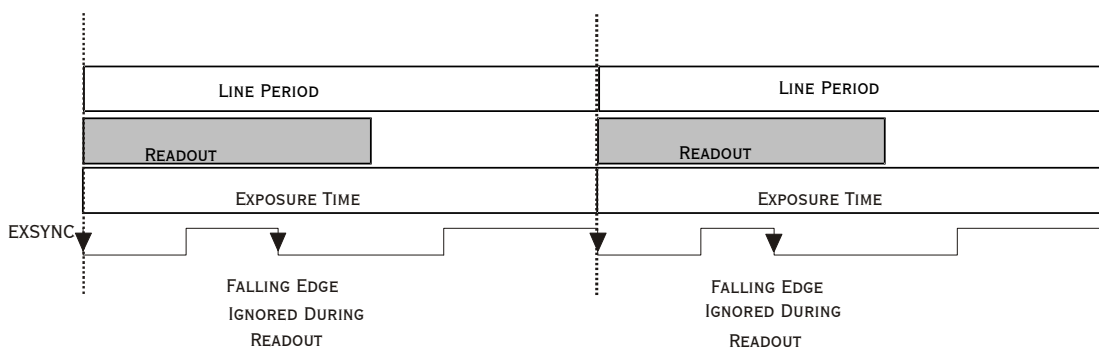
Example 1: Exposure Time less than Line Period



Mode 3: External Trigger with Maximum Exposure

Line rate is set by the period of the external trigger pulses. The falling edge of the external trigger marks the beginning of the exposure.

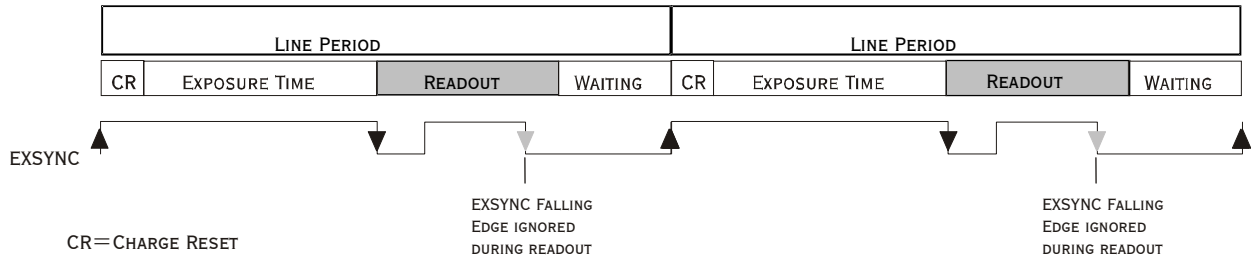
Example 2: Line Rate is set by External Trigger Pulses.



Mode 4: Smart EXSYNC, External Line Rate and Exposure Time

In this mode, EXSYNC sets both the line period and the exposure time. The rising edge of EXSYNC marks the beginning of the exposure and the falling edge initiates readout.

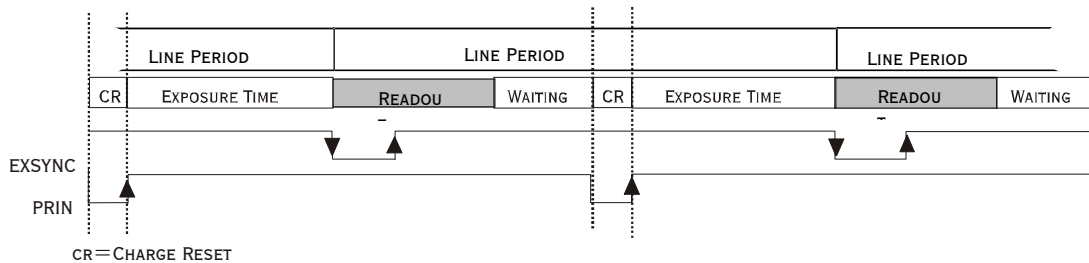
Example 3: Trigger Period is Repetitive and Greater than Read Out Time.



Mode 5: External Line Rate (EXSYNC) and External Pixel Reset (PRIN)

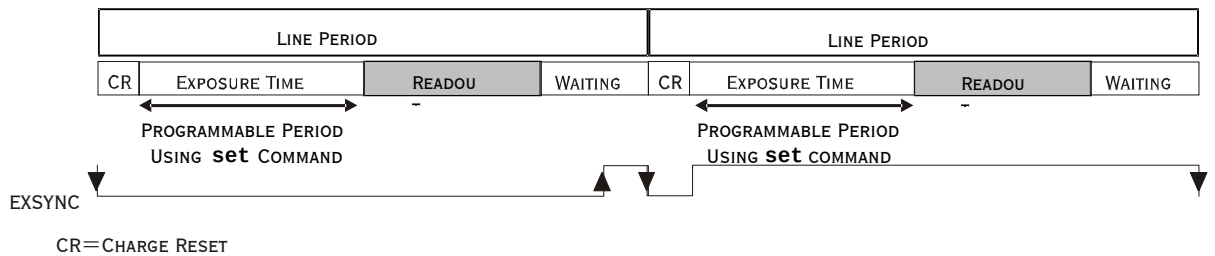
In this mode, the falling edge of EXSYNC sets the line period and the rising edge of PRIN sets the start of exposure time.

Figure 18: EXSYNC controls Line Period and PRIN controls Exposure Time



Mode 6: External Line Rate and Internally Programmable Exposure Time

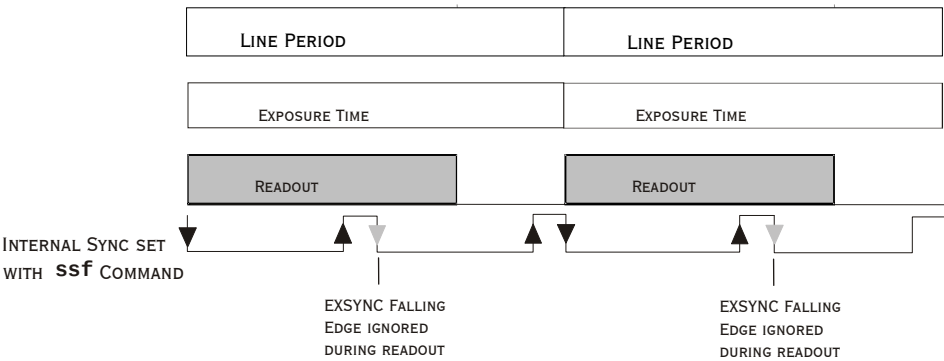
Figure 19: EXSYNC controls Line Period with Internally controlled Exposure Time



Mode 7: Internally Programmable Line Rate, Maximum Exposure Time

In this mode, the line rate is set internally with a maximum exposure time.

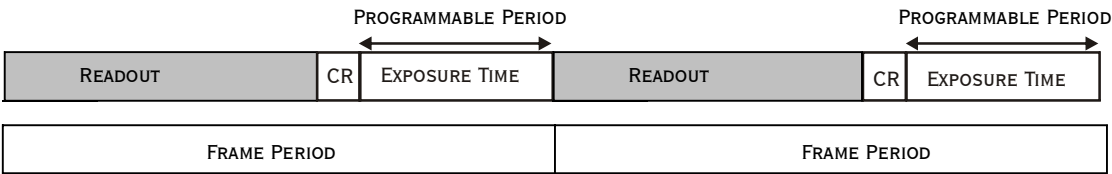
Figure 20: Mode 7 Camera Timing



Mode 8: Maximum Line Rate, Programmable Exposure Time

In this mode, the exposure time is set internally with a maximum line rate.

Figure 21: Mode 8 Timing



CR=CHARGE RESET

Setting the Readout Mode

Refer to the Clearing Dark Current section, page 62, for more information on this feature.

Use this command to clear out dark current charge collected in the vertical transfer gates immediately before the sensor is read out.

ReadoutMode

Auto. Clears dark current below ~ 45% of the maximum line rate.

DarkCurrent. Dark current clear. Always clears dark. Reduces the maximum line rate.

ImmediateReadout. Immediate readout. Does not clear dark current. (Default mode.)

- The vertical transfer gates collect dark current during the line period. This collected current is added to the pixel charge. This additional charge is especially noticeable at slower line rates.
- This value is saved with the camera settings.
- If the user is in **DalsaExposureMode 2** or **7** and **ReadoutMode 2**, with **AcquisitionLineRateAbs** at 45% of the maximum, and then **ReadoutMode 1** is selected, the following warning will be displayed, but the **AcquisitionLineRateAbs** value will not be changed: Warning 09: Internal line rate inconsistent with readout time> The effect in both internal and external line rate modes is that an EXSYNC is skipped and, therefore, the output will be at least twice as bright.

Related Commands: **DALSAExposureMode**, **AcquisitionLineRateAbs**



Applies to Modes 2 and 7

Setting the Line Rate

Sets the camera's line rate in Hz. Camera must be operating in exposure mode 2 or 7.

AcquisitionLineRateAbs = line rate in Hz.

Desired line rate in Hz. Allowable values are:

1k 1 tap: **300-36000** Hz

1k 2 tap: **300-68000** Hz

2k 1 tap: **300-18500** Hz

2k 2 tap: **300-36000** Hz

4k 2 tap: **300-18500** Hz

Related Commands: **DALSAExposureMode**, **ExposureTimeAbs**



Applies to Modes 2 and 8

Setting the Exposure Time

Sets the camera's exposure time in μ s. Camera must be operating in mode 2, 6, or 8.

ExposureTimeAbs = exposure time in μ s. Allowable range is 3 to 3300 μ s.*

- If you enter an invalid line rate frequency, an error message is returned.
- *The exposure time range is based on the current line rate.

Related Commands: **DALSAExposureMode**, **AcquisitionLineRateAbs**

5.6 Configuring the GPIO Connector

The following commands provide a connection between the GPIO controller and the camera's internal functions.

Setting the GPIO Output Signal

Sets the signal type for the selected output.

GPIOSelector

Output to set.

Port0 = Output 0, pin 11 (TTL) or 11 and 12 (LVDS)

Port1 = Output 1, pin 13 (TTL) or 13 and 14 (LVDS)

Port2 = Output 2, pin 15 (TTL) or 15 and 10 (LVDS)

Port3 = Output 3, pin 9 (TTL)

GPIOOutput

Signal type.

0 = Disable

1 = TTL

2 = LVDS

Related Commands: **GPIOInput**

Setting the GPIO Input Signal

Sets the signal type for the selected input.

GPIOSelector

Input to set.

Port0 = Input 0, Pin 1 (TTL) or 1 and 2 (LVDS)

Port1 = Input 1, Pin 3 (TTL) or 3 and 4 (LVDS)

Port2 = Input 2, Pin 6 (TTL) or 6 and 7 (LVDS)

Port3 = Input 3, Pin 8 (TTL)

GPIOInput

Signal type.

0 = Disabled

1 = TTL

2 = LVDS

Related Commands: **GPIOSelector**

5.7 Data Processing

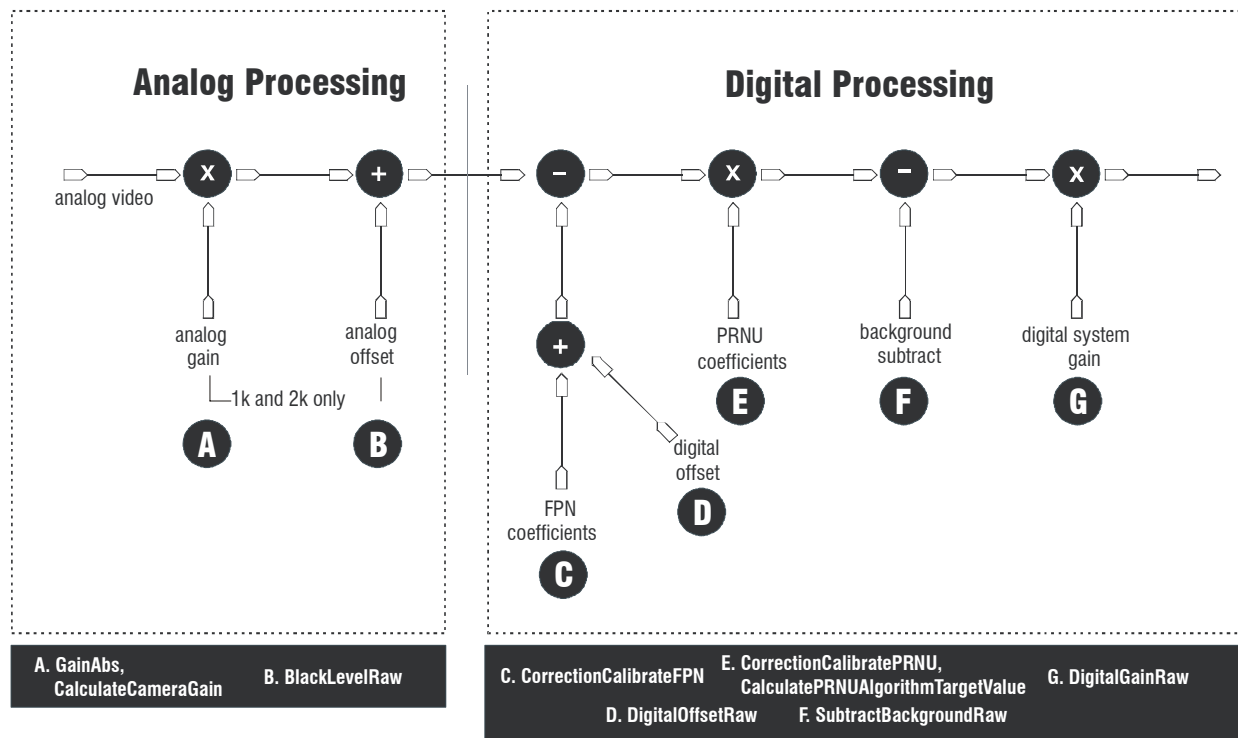
Processing Chain Overview and Description

The following diagram shows a simplified block diagram of the camera's analog and digital processing chain. The analog processing chain begins with an analog gain adjustment, followed by an analog offset adjustment. These adjustments are applied to the video analog signal prior to its digitization by an A/D converter.

The digital processing chain contains the FPN correction, the PRNU correction, the background subtract, and the digital gain and offset. Non-linearity look-up table (LUT) correction is available for the 4k model of camera.

All of these elements are user programmable.

Figure 22: Signal Processing Chain



Analog Processing

Optimizing offset performance and gain in the analog domain allows you to achieve a better signal-to-noise ratio and dynamic range than you would achieve by trying to optimize the offset in the digital domain. As a result, perform all analog adjustments prior to any digital adjustments.

1. Analog gain (GainAbs or CalibrateCameraGainTargetValue command) is multiplied by the analog signal to increase the signal strength before the A/D conversion. It is used to take advantage of the full dynamic range of the A/D converter. For example, in a low light situation the brightest part of the image may be consistently coming in

at only 50% of the DN. An analog gain of 6 dB (2x) will ensure full use of the dynamic range of the A/D converter. Of course the noise is also increased. Note: To maintain valid LUT calibration, do not use the **GainAbs** command with the 4k model. Instead, use the **DigitalGainRaw** command.

2. The analog offset (**BlackLevelRaw** command) or black level is an “artificial” offset introduced into the video path to ensure that the A/D is functioning properly. The analog offset should be set so that it is at least 3 times the rms noise value at the current gain.

Digital Processing

To optimize camera performance, digital signal processing should be completed after any analog adjustments.

1. Fixed pattern noise (FPN) calibration (calculated using the **CorrectionCalibrateFPN** command) is used to subtract away individual pixel dark current.
2. The digital offset (**DigitalOffsetRaw** command) enables the subtraction of the “artificial” A/D offset (the analog offset) so that application of the PRNU coefficient doesn't result in artifacts at low light levels due to the offset value. You may want to set the **DigitalOffsetRaw** value if you are not using FPN correction but want to perform PRNU correction.
3. Photo-Response Non-Uniformity (PRNU) coefficients (calculated using the **CorrectionCalibratePRNU** or **CalculatePRNUAlgorithmTargetValue** commands) are used to correct the difference in responsivity of individual pixels (i.e. given the same amount of light different pixels will charge up at different rates) and the change in light intensity across the image either because of the light source or due to optical aberrations (e.g. there may be more light in the center of the image). PRNU coefficients are multipliers and are defined to be of a value greater than or equal to 1. This ensures that all pixels will saturate together.
4. Background subtract (**SubtractBackgroundRaw** command) and system (digital) gain (**DigitalGainRaw** command) are used to increase image contrast after FPN and PRNU calibration. It is useful for systems that process 8-bit data but want to take advantage of the camera's 12 bit digital processing chain. For example, if you find that your image is consistently between 128 and 255DN(8 bit), you can subtract off 128 (**SubtractBackgroundRaw 2048**) and then multiply by 2 (**DigitalGainRaw 8192**) to get an output range from 0 to 255.

Analog Signal Processing: Setting Analog Gain and Offset

All analog signal processing chain commands should be performed prior to FPN and PRNU calibration and prior to digital signal processing commands.

Note: This command will invalidate the LUT calibration for the 4k model of camera. Use the **DigitalGainRaw** command instead.

Setting Analog Gain

Sets the camera's analog gain value. Analog gain is multiplied by the analog signal to increase the signal strength before the A/D conversion. It is used to take advantage of the full dynamic range of the A/D converter.

GainSelector

Tap selection:

All or **Tap1** to **Tap2** for individual tap selection.

GainAbs

Gain value in a range from **-10** to **+10dB**.

- Not available on the 4k model.

Related Commands: [CalculateCameraGain](#)

Calibrating Camera Gain

Instead of manually setting the analog gain to a specific value, the camera can determine appropriate gain values. This command calculates and sets the analog gain according to the algorithm determined by the first parameter.

CameraGainAlgorithmSelector

Calibration algorithm to use.

- 1** = This algorithm adjusts analog gain so that 8% to 13% of tap region of interest (ROI) pixels are above the specified target value (i.e. CalculateCameraGainTargetValue).
- 2** = This algorithm adjusts analog gain so that the average pixel value in tap's ROI is equal to the specified target value (i.e. CalculateCameraGainTargetValue).
- 3** = This algorithm adjusts digital gain so that the average pixel value in tap's ROI is equal to the specified target (i.e. CalculateDigitalCameraGainTarget).
- 4** = This algorithm adjusts the analog gain so that the peak tap ROI pixels are adjusted to the specified target (i.e. CalculateCameraGainTargetValue).

CalculateCameraGainTargetValue

Calculation target value in a range from **1024** to **4055** DN (12 bit LSB).

- This function requires constant light input while executing.
- If very few tap pixels are within the ROI, gain calculation may not be optimal.
- When all taps are selected, taps outside of the ROI are set to the average gain of the taps that are within the ROI.
- Perform analog gain algorithms before performing FPN and PRNU calibration.
- All digital settings affect the analog gain calibration. If you do not want the digital processing to have any effect on the camera gain calibration, then turn off all digital settings by sending the commands: **DigitalOffsetRaw 0**, **EnablePixelCoefficients 0**, **SubtractBackgroundRaw 0**, and **DigitalGainRaw 4096**
- Only algorithm 3 available on 4k models.

Related Commands: **GainAbs**, **DigitalGainRaw**

4k model

CalculateDigitalCameraGain = This algorithm adjusts digital gain so that the average pixel value in tap's ROI is equal to the specified target (i.e. CalculateDigitalCameraGainTarget).

CalculateDigitalCameraGainTarget = Target of the digital gain calibration algorithm.

Setting Analog Offset

Sets the analog offset. The analog offset should be set so that it is at least 3 times the rms noise value at the current gain. DALSA configures the analog offset for the noise at the maximum specified gain and as a result you should not need to adjust the analog offset.

BlackLevelSelector

Tap selection: **All**, **Tap1**, or **Tap2** for individual tap selection if you are using the two tap model.

BlackLevelRaw

Offset value in a range from **0** to **255** DN (12 bit LSB).

To update the analog gain reference:

Sets the current analog gain setting to be the 0dB point. This is useful after tap gain matching allowing you to change the gain on all taps by the same amount.

GenICam features for updating the analog gain reference:

UpdateGainReference

Calibrating the Camera to Remove Non-Uniformity (Flat Field Correction)

Flat Field Correction Overview

Note: The QuickCam software that ships with the Spyder3 GEV camera has a flat field correction wizard. For easy flat field correction, use the wizard located on the Calibration tab.

This camera has the ability to calculate correction coefficients in order to remove non-uniformity in the image. This video correction operates on a pixel-by-pixel basis and implements a two point correction for each pixel. This correction can reduce or eliminate image distortion caused by the following factors:

- Fixed Pattern Noise (FPN)
- Photo Response Non Uniformity (PRNU)
- Lens and light source non-uniformity

Correction is implemented such that for each pixel:

$$V_{\text{output}} = [(V_{\text{input}} - \text{FPN}(\text{pixel}) - \text{digital offset}) * \text{PRNU}(\text{pixel}) - \text{Background Subtract}] \times \text{System Gain}$$

where	V_{output}	=	digital output pixel value
	V_{input}	=	digital input pixel value from the CCD
	$\text{PRNU}(\text{pixel})$	=	PRNU correction coefficient for this pixel
	$\text{FPN}(\text{pixel})$	=	FPN correction coefficient for this pixel
	Background Subtract	=	background subtract value
	System Gain	=	digital gain value

The algorithm is performed in two steps. The fixed offset (FPN) is determined first by performing a calibration without any light. This calibration determines exactly how much offset to subtract per pixel in order to obtain flat output when the CCD is not exposed.

The white light calibration is performed next to determine the multiplication factors required to bring each pixel to the required value (target) for flat, white output. Video output is set slightly above the brightest pixel (depending on offset subtracted).

Flat Field Correction Restrictions

It is important to do the FPN correction first. Results of the FPN correction are used in the PRNU procedure. We recommend that you repeat the correction when a temperature change greater than 10°C occurs or if you change the analog gain, integration time, or line rate.

Note: If your illumination or white reference does not extend the full field of view of the camera, the camera will send a warning.

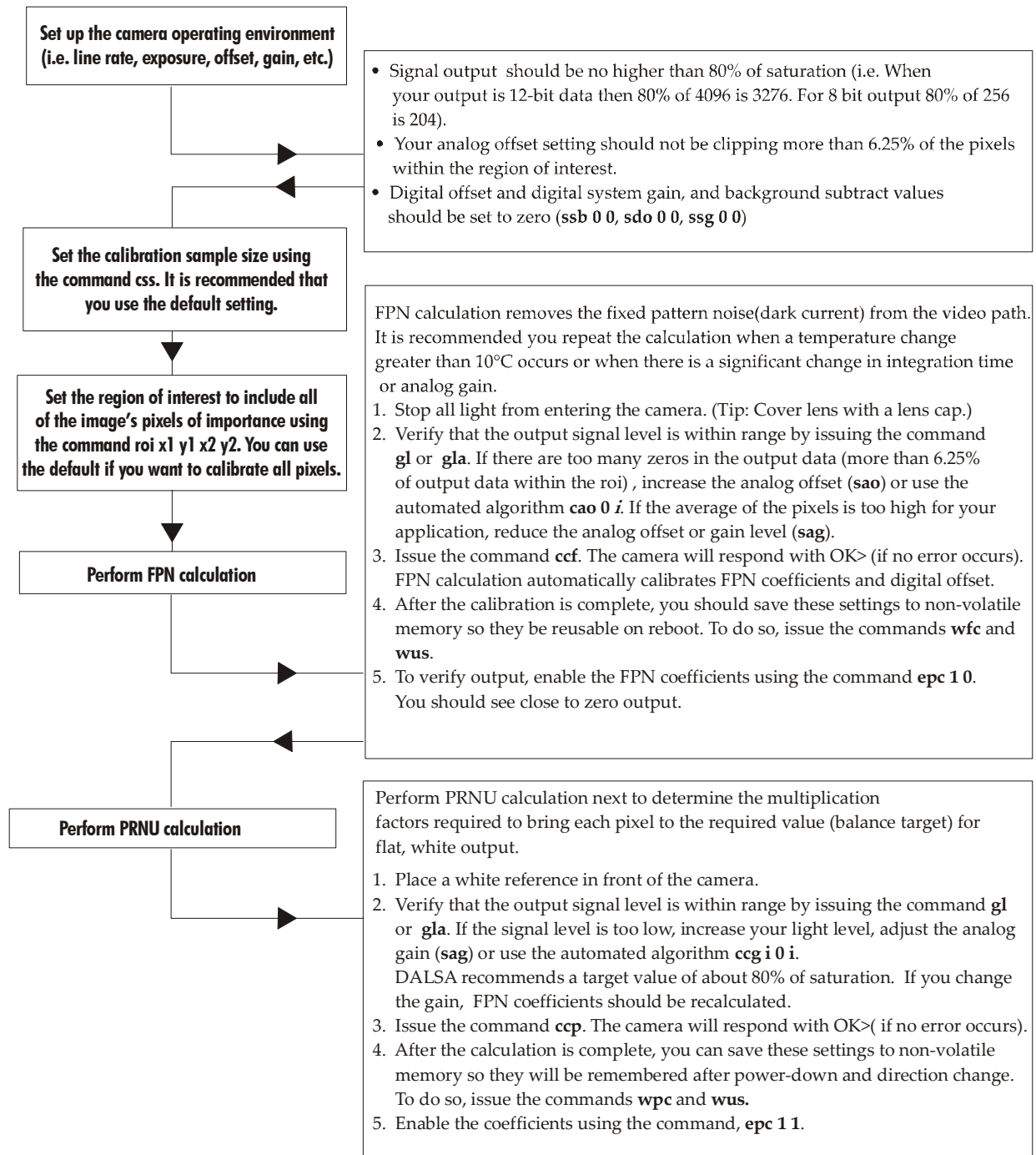
PRNU correction requires a clean, white reference. The quality of this reference is important for proper calibration. White paper is often not sufficient because the grain in the white paper will distort the correction. White plastic or white ceramic will lead to better balancing.

For best results, ensure that:

- 50 or 60 Hz ambient light flicker is sufficiently low not to affect camera performance and calibration results.
- For best results, the analog gain should be adjusted for the expected operating conditions and the ratio of the brightest to darkest pixel in a tap should be less than 3 to 1 where:

$$3 > \frac{\text{Brightest Pixel (per tap)}}{\text{Darkest Pixel (per tap)}}$$

- The camera is capable of operating under a range of 8 to 1, but will clip values larger than this ratio.
- The brightest pixel should be slightly below the target output.
- When 6.25% of pixels from a single row within the region of interest are clipped, flat field correction results may be inaccurate.
- Correction results are valid only for the current analog gain and offset values. If you change these values, it is recommended that you recalculate your coefficients.



Note: All commands listed above are described in detail in the following sections in the order that they should be performed.

Digital Signal Processing

To optimize camera performance, digital signal processing should be completed after any analog adjustments.

FPN Correction

Performing FPN Correction

Performs FPN correction and eliminates FPN noise by subtracting away individual pixel dark current.

CorrectionCalibrateFPN

- Perform all analog and digital adjustments before performing FPN correction.
- Perform FPN correction before PRNU correction.
- Refer to *Calibrating the Camera to Remove Non-Uniformity (Flat Field Correction)* on page 47 for a procedural overview on performing flat field correction.
- To save FPN coefficients after calibration, use the [WriteFPNCoefficients](#) command.
- The QuickCam software that ships with the Spyder3 GEV camera has a flat field correction wizard. For easy flat field correction, use the wizard located on the Calibration tab.

Related Commands: **CorrectionCalibratePRNU**, **WriteFPNCoefficients**

Setting Digital Offset

Purpose:

Sets the digital offset. Digital offset is set to zero when you perform FPN correction ([CorrectionCalibrateFPN](#) command). If you are unable to perform FPN correction, you can partially remove FPN by adjusting the digital offset.

DigitalOffsetSelector

Tap selection. **All**, **Tap1** or **Tap2** depending on camera model.

DigitalOffsetRaw

Subtracted offset value in a range from **0** to **2048**

- When subtracting a digital value from the digital video signal, the output can no longer reach its maximum unless you apply digital gain using the **DigitalGainRaw** command. See the previous section for details on the **DigitalGainRaw** command.

Related Commands: **DigitalGainRaw**

PRNU Correction White Balance

Performing PRNU to a user entered value

Performs PRNU calibration to user entered value and eliminates the difference in responsivity between the most and least sensitive pixel creating a uniform response to light. Using this command, you must provide a calibration target.

Executing these algorithms causes the **SubtractBackgroundRaw** command to be set to 0 (no background subtraction) and the **DigitalGainRaw** command to 4096 (unity digital gain). The pixel coefficients are disabled (**EnablePixelCoefficients 0**) during the algorithm execution but returned to the state they were prior to command execution.

CalculatePRNUAlgorithmTargetValue

PRNU calibration algorithm to use:

1 = This algorithm first adjusts each tap's analog gain so that 8-13% of pixels within a tap are above the value specified in the target value parameter. PRNU calibration then occurs using the peak pixel in the region of interest.

This algorithm is recommended for use only when FPN is negligible and FPN coefficients are set to zero. Since this algorithm adjusts the analog gain, it also affects FPN. If FPN is calibrated prior to running this algorithm, FPN will be observable in dark conditions and an incorrect FPN value will be used during PRNU calibration resulting in incorrect PRNU coefficients.

2 = Calculates the PRNU coefficients using the entered target value as shown below:

$$\text{PRNU Coefficient}_i = \frac{\text{Target}}{(\text{AVG Pixel Value}_i) - (\text{FPN}_i + \text{sdo value})}$$

The calculation is performed for all sensor pixels but warnings are only applied to pixels in the region of interest. This algorithm is useful for achieving uniform output across multiple cameras. Is is important that the target value (set with the next parameter) is set to be at least equal to the highest pixel across all cameras so that all pixels can reach the highest pixel value during calibration.

3 = This algorithm includes an analog gain adjustment prior to PRNU calibration. Analog gain is first adjusted so that the peak pixel value in tap's ROI is within 97 to 99% of the specified target value. It then calculates the PRNU coefficients using the target value as shown below:

$$\text{PRNU Coefficient}_i = \frac{\text{Target}}{(\text{AVG Pixel Value}_i) - (\text{FPN}_i + \text{sdo value})}$$

The calculation is performed for all sensor pixels but warnings are only applied to pixels in the region of interest. This algorithm is useful for achieving uniform output across multiple cameras.

This algorithm is useful for achieving uniform output across multiple cameras by first adjusting analog gain and then performing PRNU calibration. This algorithm is recommended for use only when FPN is negligible and FPN coefficients are set to zero. Since this algorithm adjusts the analog gain, it also affects FPN. If FPN is calibrated prior to running this algorithm, FPN will be observable in dark conditions and an incorrect FPN value will be used during PRNU calibration resulting in

incorrect PRNU coefficients.

This algorithm is more robust and repeatable than algorithm 1 because it uses an average pixel value rather than a number above target. However, this algorithm is slower.

i

Peak target value in a range from 1024 to 4055DN. The target value must be greater than the current peak output value.

Notes:

- Perform all analog adjustments before calibrating PRNU.
- This command performs the same function as the **cpp** command but forces you to enter a target value.
- Calibrate FPN before calibrating PRNU. If you are not performing FPN calibration then issue the **rpc** (reset pixel coefficients) command and set the **sdo** (set digital offset) value so that the output is near zero under dark.
- The QuickCam software that ships with the Spyder3 GEV camera has a flat field correction wizard. For easy flat field correction, use the wizard located on the Calibration tab.
- Only algorithm 2 is available for the 4k camera models.

CalculatePRNUAlgorithm = Peak target value in a range from 1024 to 4055DN

Note: Algorithm for this feature is preset to 2.

4k model

CalculatePRNUAlgorithmTargetValue = Peak target value in a range from 1024 to 4055DN

CalculatePRNUCoefficients = Executes the command.

Performing PRNU Correction to a Camera Calculated Value

Performs PRNU correction and eliminates the difference in responsivity between the most and least sensitive pixel creating a uniform response to light.

CorrectionCalibratePRNU

- Perform all analog adjustments before calculating PRNU.
- Perform FPN correction before PRNU correction.
- If FPN cannot be calibrated, use the **ResetPixelCoefficients** command to reset all coefficients to zero, and save them to memory with the [WriteFPNCoefficients](#) command. You can then adjust the digital offset (**DigitalOffsetRaw** command) to remove some of the FPN.
- Ensure camera is operating at its expected analog gain, integration time, and temperature.
- Refer to Calibrating the Camera to Remove Non-Uniformity (Flat Field Correction) on page 47 for a procedural overview on performing flat field correction.
- To save FPN coefficients after calibration, use the [WritePRNUCoefficients](#) command. Refer to section Saving and Restoring PRNU and FPN Coefficients for details.
- The QuickCam software that ships with the Spyder3 GEV camera has a flat field

correction wizard. For easy flat field correction, use the wizard located on the Calibration tab.

Related Commands: **CorrectionCalibrateFPN**,
CalculatePRNUAlgorithmTargetValue

CalculatePRNUAlgorithmTargetValue

- Perform all analog adjustments before calibrating PRNU.
- This command performs the same function as the **CorrectionCalibratePRNU** command but forces you to enter a target value.
- Calibrate FPN before calibrating PRNU. If you are not performing FPN calibration then issue the **ResetPixelCoefficients** (reset pixel coefficients) command and set the **DigitalOffsetRaw** (set digital offset) value so that the output is near zero under dark.
- Note: Refer to Calibrating the Camera to Remove Non-Uniformity (Flat Field Correction) on page 47 for a procedural overview on performing flat field correction.

Subtracting Background

Use the background subtract commands after performing flat field correction if you want to improve your image in a low contrast scene. It is useful for systems that process 8 bit data but want to take advantage of the camera's 12 bit digital processing chain. You should try to make your darkest pixel in the scene equal to zero.

SubtractBackgroundSelector

Tap selection. **All**, **Tap1** to **Tap2** depending on camera model.

SubtractBackgroundRaw

Subtracted value in a range in DN from **0** to **4095**.

- When subtracting a digital value from the digital video signal the output can no longer reach its maximum. Use the [DigitalGainRaw](#) command to correct for this where:

$$\text{ssg value} = \frac{\text{max output value}}{\text{max output value} - \text{ssb value}}$$

Related Commands: **DigitalGainRaw**

Setting Digital System Gain

Improves signal output swing after a background subtract. When subtracting a digital value from the digital video signal, using the **SubtractBackgroundRaw** command, the output can no longer reach its maximum. Use this command to correct for this where:

$$\text{ssg value} = \frac{\text{max output value}}{\text{max output value} - \text{ssb value}}$$

GainSelector

Tap selection. **All**, **Tap1** to **Tap2**.

DigitalGainRaw

Gain setting. The gain ranges are **0** to **65535**. The digital video values are multiplied by this value where:

$$\text{Digital Gain} = \frac{i}{4096}$$

Use this command in conjunction with the **SubtractBackgroundRaw** command.

- 4k model limited to 12953 (0 dB effective at factory set analog gain of -10 dB).

Related Commands: **SubtractBackgroundRaw**

Returning Calibration Results and Errors

Enabling and Disabling Pixel Coefficients

Enables and disables FPN and PRNU coefficients.

EnablePixelCoefficients

DisableFPNEnablePRN
EnableFPNDisablePRNU
EnableFPNEnablePRNU
DisableFPNDisablePRNU

End-of-line Sequence

Produces an end-of-line sequence that provides basic calculations including "line counter", "line sum", "pixels above threshold", "pixels below threshold", and "derivative line sum" within the region of interest. These basic calculations are used to calibrate analog offset and calibrate analog gain.

To further aid in debugging and cable/data path integrity, the first three pixels after Line Valid are "aa", "55", "aa". Refer to the following table. These statistics refer only to pixels within the region of interest.

EnablePixelCoefficients

Disable end-of-line sequence

Enable end-of-line sequence

Table 11: End-of-Line Sequence Description

Location	Value	Description
1	A's	By ensuring these values consistently toggle between "aa" and "55", you can verify cabling (i.e. no stuck bits)
2	5's	

Location	Value	Description
3	A's	
4	4 bit counter LSB justified	Counter increments by 1. Use this value to verify that every line is output
5	Line sum (7...0)	Use these values to help calculate line average and gain
6	Line sum (15...8)	
7	Line sum (23...16)	
8	Line sum (31...24)	
9	Pixels above threshold (7...0)	Monitor these values (either above or below threshold) and adjust camera digital gain and background subtract to maximize scene contrast. This provides a basis for automatic gain control (AGC)
10	Pixels above threshold (15...8)	
11	Pixels below threshold (7...0)	
12	Pixels below threshold (15...8)	
13	Differential line sum (7..0)	Use these values to focus the camera. Generally, the greater the sum the greater the image contrast and better the focus.
14	Differential line sum (15...8)	
15	Differential line sum (23...16)	
16	Differential line sum (31...24)	

Setting Thresholds

Setting an Upper Threshold

Sets the upper threshold limit to report in the end-of-line sequence.

UpperThresholdLimitRaw

Upper threshold limit in range from **0** to **4095**.

- LVAL is not high during the end-of-line statistics.

Setting a Lower Threshold

Sets the lower threshold limit to report in the end-of-line sequence.

LowerThresholdLimitRaw

Lower threshold limit in range from **0** to **4095**.

- LVAL is not high during the end-of-line statistics.

Related Commands: • **UpperThresholdLimitRaw**

Look-Up Tables

Note: This information only applies to the 4k model camera.

The flat field corrections FPN and PRNU assume a linear response to the amount of light by the sensor, output node, analog amplifier, and analog to digital converter. To correct any non-linearity in this system of components a Look-Up Table (LUT) has been implemented in the FPGA for each tap immediately after the ADC. The LUT adds a signed value (-256 to +255) indexed by the 10 MSB of the input value.

Look-up tables (LUTs) are only used by the 4K mono cameras.

The user can enable or disable the LUT. LUTs are factory calibrated and cannot be altered. They are designed to assist the analog amplifier in making its output linear.

The LUTs need to be recalibrated when the analog gain changes. This means that the **GainAbs** command is disabled in the 4K in order to prevent conflict issues.

The calibration will change with changes to sensitivity modes and direction. Therefore DALSA automatically loads a calibrated LUT when there are changes to sensitivity and direction.

5.8 Saving and Restoring Settings

For each camera operating mode (high sensitivity forward direction, high sensitivity reverse direction, low sensitivity, or tall pixel), the camera has distinct factory settings, current settings, and user settings. In addition, there is one set of factory pre-calibrated pixel coefficients and up to four sets of user created pixel coefficients for each operating mode.

Factory Settings

On first initialization, the camera operates using the factory settings. You can restore the original factory settings at any time using the command **RestoreFactorySettings**.

GenICam features for restoring the factory setting:

RestoreFactorySettings

User Settings

You can save or restore your user settings to non-volatile memory using the following commands. Pixel coefficients and LUTs are stored separately from other data.

- To save all current user settings to EEPROM, use the command **WriteUserSetting**. The camera will automatically restore the saved user settings when powered up. **Note:** While settings are being written to nonvolatile memory, do not power down camera or camera memory may be corrupted.
- To restore the last saved user settings, use the command **RestoreUserSetting**.
- To save the current pixel coefficients, use the command **WritePRNUCoefficients** and **WriteFPNCoefficient**.

- To restore the last saved pixel coefficients, use the command **LoadPixelCoefficients**.

Current Session Settings

These are the current operating settings of your camera. To save these settings to non-volatile memory, use the command **WriteUserSetting**.

Saving and Restoring PRNU and FPN Coefficients

Saving the Current PRNU Coefficients

Saves the current PRNU coefficients. You can save up to four sets of pixel coefficients

WriteFPNCoefficients = 1, 2, 3, 4

4k model

PixelSetSelector = set 1, set 2, set 3, set 4

WriteFPNCoefficients = Executes the command.

Saving the Current FPN Coefficients

Saves the current FPN coefficients. You can save up to four sets of pixel coefficients

WriteFPNCoefficients = 1, 2, 3, 4

4k model

PixelSetSelector = set 1, set 2, set 3, set 4

WriteFPNCoefficients = Executes the command.

Loading a Saved Set of Coefficients

Loads a saved set of pixel coefficients. A factory calibrated set of coefficients is available.

LoadPixelCoefficients = 0, 1, 2, 3, 4

PixelSetSelector = set 0, set 1, set 2, set 3, set 4

LoadPixelCoefficients = Executes the command.

Resetting the Current Pixel Coefficients

Resets the current pixel coefficients to zero. This command does not reset saved coefficients.

ResetPixelCoefficients

The digital offset is not reset.

Rebooting the Camera

The command **DeviceReset** reboots the camera. The camera starts up with the last saved settings and the baud rate used before reboot. Previously saved pixel coefficients are also restored.

DeviceReset

5.9 Diagnostics

Generating a Test Pattern

Generates a test pattern to aid in system debugging. The test patterns are useful for verifying camera timing and connections. The following tables show each available test pattern.

TestImageSelector

{Ramp12bits, Step8bits, iPORTTestPattern}

- 0 Video.
- 1 12 bit ramp test pattern.



2 tap model



1 tap model

- 2 8 bit step test pattern.



2 tap model

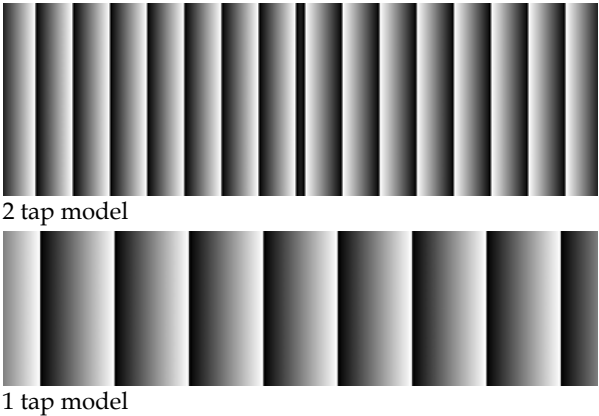


1 tap model

Ethernet Test Pattern

A third test pattern—Ethernet—is accessible using the QuickCam GUI.

Purpose:	Generates a test pattern to aid in system debugging. The test patterns are useful for verifying camera timing and connections. The following table shows the ethernet test pattern available through the QuickCam GUI.
Availability:	Under the Diagnostics tab in the Test Patter drop-down list. Ethernet.



Temperature Measurement

To determine the temperature of the camera, use the **CameraTemperatureAbs** command. This command will return the internal chip case temperature in degrees Celsius. For proper operation, this value should not exceed 75°C.

Note: If the camera reaches 75°C, the camera will shutdown and the LED will flash red. If this occurs, the camera must be rebooted using the command, **DeviceReset** or can be powered down manually. You will not be able to restart the camera until the temperature is less than 65°C. You will have to correct the temperature problem or the camera will shutdown again. The camera allows you to send the **CameraTemperatureAbs** (verify temperature) command while it is in this state.

Voltage Measurement

The command **CameraVoltage** displays the camera’s input voltage. Note that the voltage measurement feature of the camera provides only approximate results (typically within 10%). The measurement should not be used to set the applied voltage to the camera, but only used as a test to isolate gross problems with the supply voltage.

GenICam features for measuring the voltage of the camera’s input voltages:
CameraVoltageAbs

Returning the LED Status

Returns the status of the camera's LED.

LEDStatus

The camera returns one of the following values:

Red (loss of functionality)

Green (camera is operating correctly)

Flashing green (camera is performing a function)

Flashing red (fatal error)

5.10 Error Handling

The following table lists warning and error messages and provides a description and possible cause.

Warning messages are returned when the camera cannot meet the full value of the request; error messages are returned when the camera is unable to complete the request.

Table 12: Warning and Error Messages

Message	Description
OK>	SUCCESS
Warning 01: Outside of specification>	Parameter accepted was outside of specified operating range (e.g. gain greater than ± 10 dB of factory setting).
Warning 02: Clipped to min>	Parameter was clipped to the current operating range.
Warning 03: Clipped to max>	Parameter was clipped to the current operating range.
Warning 04: Related parameters adjusted>	Parameter was clipped to the current operating range.
Warning 05: Can't set LVDS for this GPIO signal	Input 3 and Output 3 cannot be set to use an LVDS signal.
Warning 07: Coefficient may be inaccurate A/D clipping has occurred>	In the region of interest (ROI) greater than 6.251% single or 1% of averaged pixel values were zero or saturated.
Warning 08: Greater than 1% of coefficients have been clipped>	A FPN/PRNU has been calculated to be greater than the maximum allowable 511 (8).
Warning 09: Internal line rate inconsistent with readout time>	

Message	Description
Error 02: Unrecognized command>	Command is not available in the current access level or it is not a valid command.
Error 03: Incorrect number of parameters>	
Error 04: Incorrect parameter value>	This response returned for · Alpha received for numeric or vice versa · Not an element of the set of possible values. E.g., Baud Rate · Outside the range limit
Error 05: Command unavailable in this mode>	Command is valid at this level of access, but not effective. Eg line rate when in smart EXSYNC mode
Error 06: Timeout>	Command not completed in time. Eg FPN/PRNU calculation when no external EXSYNC is present.
Error 07: Camera settings not saved>	Tried saving camera settings (RestoreFactorySettings/RestoreUserSettings) but they cannot be saved.
Error 08: Unable to calibrate - tap outside ROI>	Cannot calibrate a tap that is not part of the region of interest.
Error 09: The camera's temperature exceeds the specified operating range>	Indicates that the camera has shut itself down to prevent damage from further overheating.

5.11 Clearing Dark Current

Gate Dark Current Clear

Image sensors accumulate dark current while they wait for a trigger signal. If the readout is not triggered in a reasonable amount of time, then this dark current accumulation may increase to an excessive amount. The result of this happening will be that the first row, and possibly additional rows (frames), of the image will be corrupt.

The sensor used in the Spyder3 GEV camera contains two sources of dark current that will accumulate with time: 1) in the photo sensitive area, and 2) in the gates used to clock-out the charge.

The gate dark current can account for approximately 20% of the total dark current present. While the exposure control has direct control over the amount of dark current in the photo sensitive area, it has no control over the charge accumulated in the gates. Even with exposure control on, at low line rates, this gate charge can cause the camera to saturate.

Using the **ReadoutMode** command, the camera user can control the camera's behavior in order to minimize the dark current artifact.

The modes of operation selected by the ReadoutMode command are: Auto, On, or Off.

Note: This command is only available in low sensitivity and tall pixel modes. High sensitivity mode operates only in the immediate read out position.

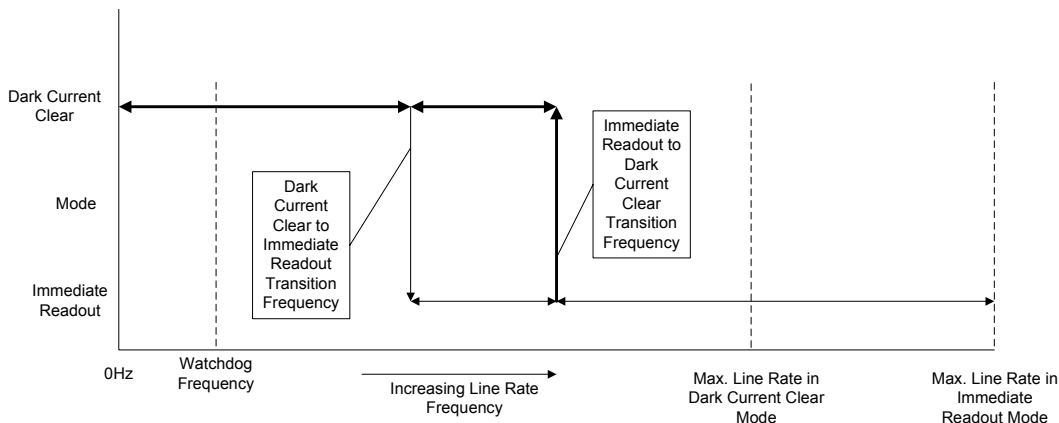


Figure 23: Gate Dark Current Clear

Table 13.

Model	Transition Frequencies	
	Dark Current Clear to Immediate Readout Transition	Immediate Readout to Dark Current Clear Transition
SG-11-01K40	13.6KHz	16.4KHz
SG-11-01K80	25.1KHz	30.4KHz
SG-11-02K40	7.05KHz	8.52KHz

SG-11-02K80	13.6KHz	16.4KHz
-------------	---------	---------

Immediate read out mode (default, ReadoutMode 2)

In this mode the image is read out, including accumulated dark current, immediately following the trigger or the EXSYNC falling edge.

There are no line rate limitations other than the amount of gate dark current that can be tolerated at low line rates.

There are no timing or exposure anomalies other than situations where EXSYNC is removed from camera. In this case, the camera will operate in a "watchdog" state.

For information on artifacts that may be experienced while using this mode, see the Artifacts section below.

Gate dark current clear mode (always on, ReadoutMode 1)

In this mode the gate dark current will be cleared continuously.

After the trigger (EXSYNC) is received, the dark current is cleared from the image sensor before the image is acquired. The line rate is limited to ½ the maximum line rate available for that model of camera.

For information on artifacts that may be experienced while using this mode, see the Artifacts section below.

Table 14.

Model	Max. Line Rate	
	Immediate Readout Mode	Dark Current Clear Mode
SG-11-01K40	36KHz	18KHz
SG-11-01K80	68KHz	34KHz
SG-11-02K40	18.5KHz	9.25KHz
SG-11-02K80	36KHz	18KHz
SG-11-04K40	18.5KHz	9.25KHz

When operating in the dark current clear mode, there will be a slight delay, equivalent to one readout time, before the actual exposure is implemented. The actual exposure time will not be altered.

Table 15.

Model	Exposure Delay and Max Exposure Time in Auto Mode
SG-11-01K40	27.5μs
SG-11-01K80	14.75 μs
SG-11-02K40	53.1 μs
SG-11-02K80	27.5 μs
SG-11-04K40	53.1μs

Auto Mode (Auto)

In this mode the line rate from the camera will automatically cause a switch between the gate dark current clear mode and non gate dark current clear mode.

The frequency of when this mode switchover occurs depends on the camera model.

In cases where the line rate is rapidly increased from below the Dark Current Clear to Immediate Readout Transition Frequency to above the Immediate Readout to Dark Current Clear Transition Frequency, the first line following this transition will likely be corrupted.

The table below outlines the artifacts that may be seen during this transition period. All subsequent lines after this occurrence will be as expected.

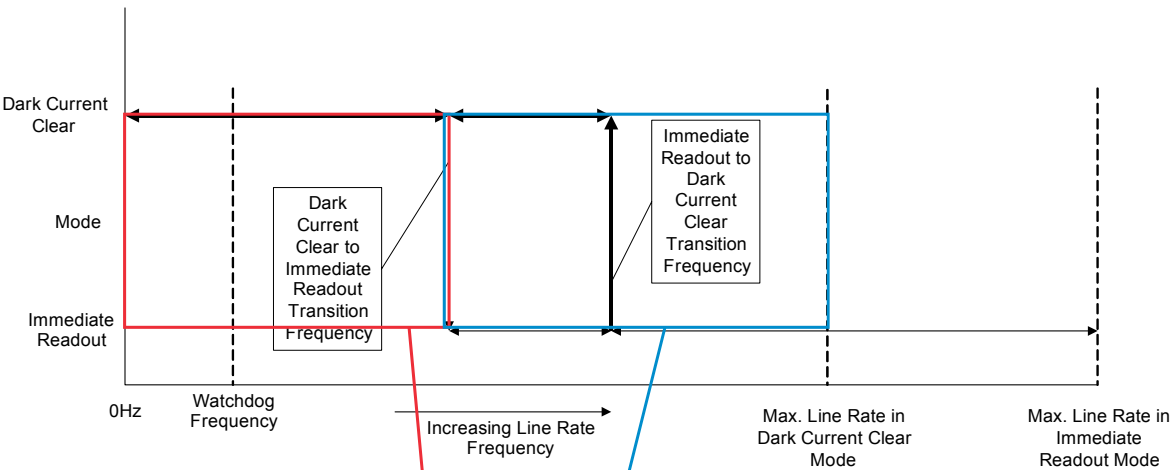
In the case of a slow transition (that is, when the EXSYNC line rate increases by less than 10% of the previous line rate) a line readout will not become corrupt.

There are also limitations on the exposure time when operating in auto mode: If the line rate exceeds half the maximum line rate, then the exposure time cannot exceed the time stated in Table 15.

Note: DALSA recommends Auto mode for most users.

For information on artifacts that may be experienced while using this mode, see the Artifacts section below.

Please note: The graphic below explains the relationship between the following tables and the preceding Figure 23. The operating regions described in the tables refer to a specific region of Figure 23.

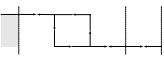


ReadoutMode 0, Auto Mode.		
Time Period	Operating Region Refer to the above figure	Operating Mode
T ₀		Dark Current Dump state
T ₁		Immediate Readout state

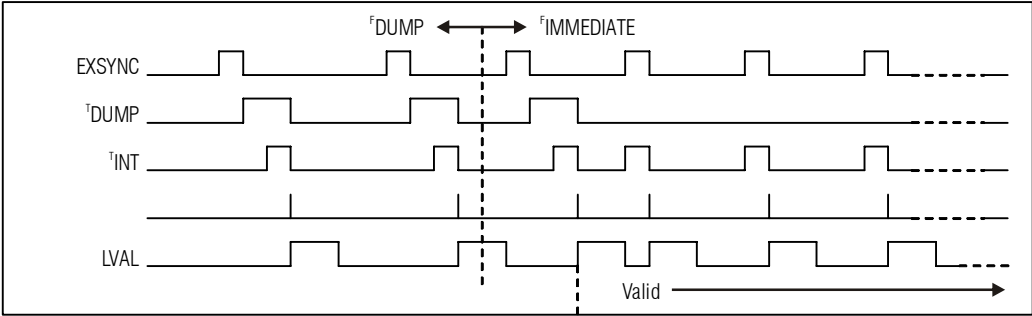
Dark Current Dump to Immediate Readout: Multi-Line Artifacts.

ReadoutMode 0, Auto Mode.		
Time Period	Operating Region Refer to Figure 23.	Operating Mode
T ₀		Dark Current Dump state
T ₁		Immediate Readout state

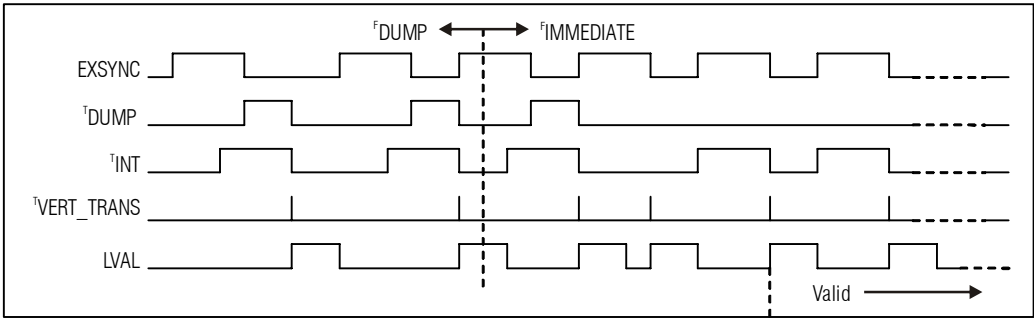
ReadoutMode 0, Auto Mode.		
Time Period	Operating Region Refer to Figure 23.	Operating Mode
T ₀		Immediate Readout state
T ₁		Dark Current Dump state
T ₂		Immediate Readout state

ReadoutMode 2, Immediate Readout Mode.		
Time Period	Operating Region Refer to Figure 23.	Operating Mode
T ₀		Dark Current Dump state
T ₁		Immediate Readout state

Dark Current Dump to Immediate Readout (T_{INT} < #)



Dark Current Dump to Immediate Readout ($T_{INT} > \#$)



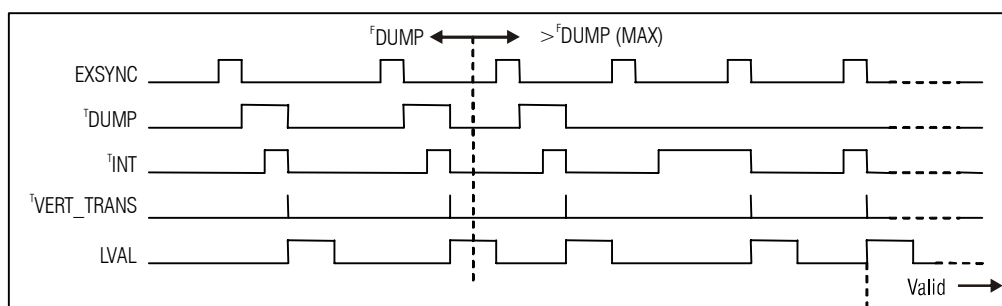
Dark Current Dump to Immediate Readout: Multi-Line Artifacts

ReadoutMode 0, Auto Mode.		
Time Period	Operating Region Refer to Figure 23.	Operating Mode
T ₀		Dark Current Dump state
T ₁		Immediate Readout state

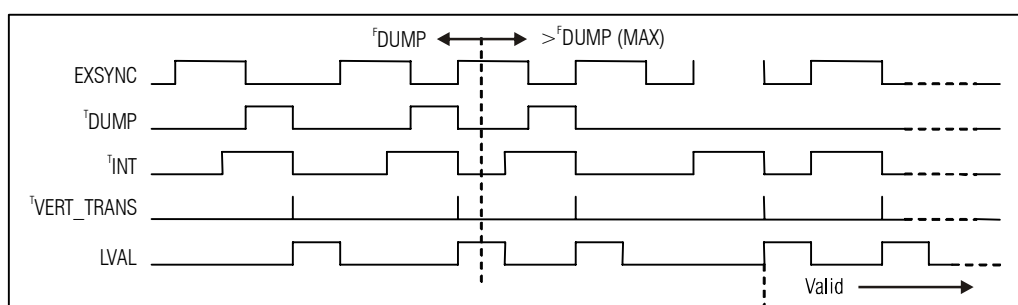
ReadoutMode 0, Auto Mode.		
Time Period	Operating Region Refer to Figure 23.	Operating Mode
T ₀		Immediate Readout state
T ₁		Dark Current Dump state
T ₂		Immediate Readout state

ReadoutMode 2, Immediate Readout Mode.		
Time Period	Operating Region Refer to Figure 23.	Operating Mode
T ₀		Dark Current Dump state
T ₁		Immediate Readout state

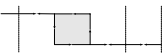
Dark Current Dump to Immediate Readout ($T_{INT} < \#$)

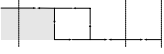
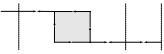
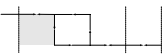


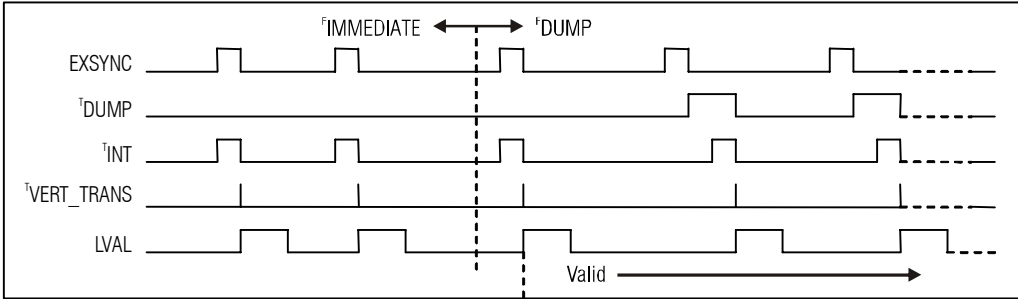
Dark Current Dump to Immediate Readout ($T_{INT} > \#$)



Immediate Readout to Dark Current Dump: Hysteresis Artifacts

ReadoutMode 0, Auto Mode.		
Time Period	Operating Region Refer to Figure 23.	Operating Mode
T ₀		Immediate Readout state
T ₁		Dark Current Dump state

ReadoutMode 0, Auto Mode.		
Time Period	Operating Region Refer to Figure 23.	Operating Mode
T ₀		Dark Current Dump state
T ₁		Immediate Readout state
T ₂		Dark Current Dump state



Setting the Readout Mode

Use this command to clear out dark current charge in the vertical transfer gates immediately before the sensor is read out.

ReadoutMode

Auto (0x0)

DarkCurrentClear (0x1)

ImmediateReadout (0x2)

Auto. Clears dark current below ~ 45% of the maximum line rate.

DarkCurrentClear. Always clears dark. Reduces the maximum line rate.

ImmediateReadout. Does not clear dark current. (Default mode.)

- The vertical transfer gates collect dark current during the line period. This collected current is added to the pixel charge. The middle two red taps have more vertical transfer gates and, therefore, more charge. This additional charge is especially noticeable at slower line rates.
- If the user is in **Exposure Modes 2: ExposureMode Timed and LineTriggerMode Off (Internal)**, or **7: ExposureMode Off and LineTriggerMode Off (Internal)**, and **ReadoutMode ImmediateReadout**, with **AcquisitionLineRateAbs** at 45% of the maximum, and then **ReadoutMode DarkCurrentClear** is selected, the following warning will be displayed, but the **AcquisitionLineRateAbs** value will not be changed: Warning 09: Internal line rate inconsistent with readout time> The effect in both internal and external line rate modes is that an EXSYNC is skipped and, therefore, the output will be at least twice as bright.
- This value is saved with the camera settings.

Related Commands: **DALSAExposureMode, AcquisitionLineRateAbs**

Appendix B

ASCII Commands

All the functionality available through the QuickCam GUI is also available through the serial interface using the camera-specific three letter commands.

There are three ways to enter ASCII commands: (1) through the QuickCam Command tab, (2) through the Configuration window, or (3) through the virtual serial port. Entering commands through the QuickCam Command window is the simplest method.

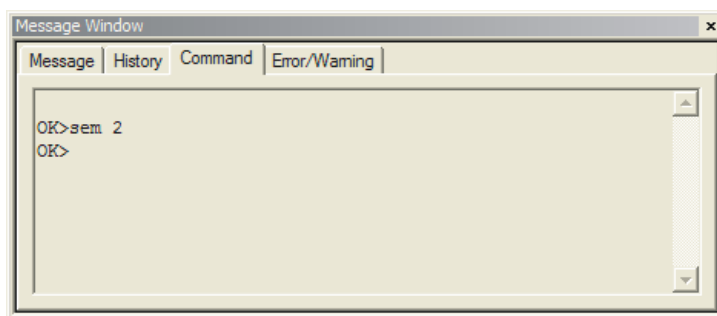
Command Window Method:

1. Open QuickCam.

In the Message Window:

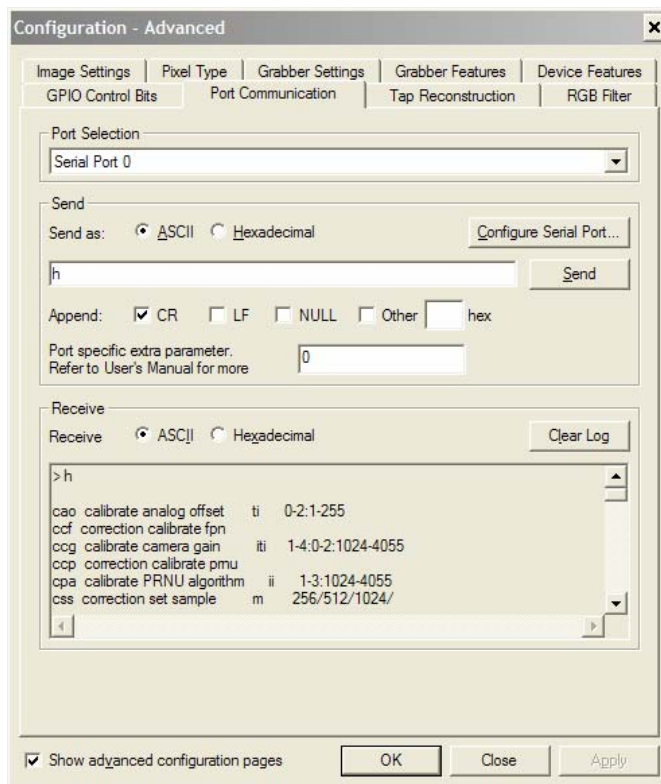
2. Open the **Command** tab.
3. At the **OK>** prompt, enter the ASCII command. Refer to Appendix A for details on all of ASCII commands available with this camera.
4. Press **Enter**.

The camera responds with **OK>** if the command was successful or an error or warning message as appropriate.

Figure 24: Command Tab after Sending the sem (Set Exposure Mode) Command**Configuration Window Method:**

1. Open QuickCam.
In the **Camera Configuration Window**:
2. Open the **Exposure/GPIO tab**.
3. Click **Advanced...**
4. Open the **Port Communication tab**.

The Port Communication tab provides an ASCII interface. In order to comply with DALSA camera command protocol, you must send and receive as ASCII and ensure that the CR checkbox is checked (default).

Figure 25: Port Communication Tab after Sending the h (Help) Command

Virtual Serial Port Method

1. Open QuickCam.
2. Select **Configure** → **Serial Port Link** to enable or disable the virtual serial port.

Some camera control tools can connect only to a Windows system serial port. To avoid asking for changes from camera manufacturers, two serial COM ports in the PC can be linked together to share the serial channel to the IP engine. Using this link, data written to one port can be read by the other port, and vice-versa.

These linked serial COM ports can be either "virtual" or physical. To set up virtual ports, use a virtual serial port driver. Some good virtual serial port drivers are available at: <http://www.softinfinity.com/> or <http://www.virtual-serial-port.com/>.

Alternatively, if a PC has two free physical serial ports, they can be connected together and used as a pair, in the same manner as a virtual serial port driver.

The Serial Port Configuration dialog box allows you to attach the serial channel in QuickCam to one port in a serial port pair, whether a physical pair or virtual pair. Therefore, an external application needs simply to connect to the other serial port of the pair to communicate with the camera.

Serial Protocol Defaults

- 8 data bits
- 1 stop bit
- No parity
- No flow control
- 9.6kbps
- Camera does not echo characters

Command Format

When entering commands, remember that:

- A carriage return <CR> ends each command.
- The camera will answer each command with either <CR><LF> "OK >" or <CR><LF>"Error xx: Error Message >" or "Warning xx: Warning Message". The ">" is always the last character sent by the camera.

The following parameter conventions are used in the manual:

- *i* = integer value
- *f* = real number
- *m* = member of a set
- *s* = string
- *t* = tap id
- *x* = pixel column number
- *y* = pixel row number

Example: to return the current camera settings

gcp <CR>

Camera ASCII Command Help

For quick help, the camera can return all available commands and parameters through the serial interface.

There are two different help screens available. One lists all of the commands available to configure camera operation. The other help screen lists all of the commands available for retrieving camera parameters (these are called “get” commands).

To view the help screen listing all of the camera configuration commands, use the command:

Syntax: **h**

To view a help screen listing all of the “get” commands, use the command:

Syntax: **gh**

The camera configuration command help screen lists all the available commands. Parameter ranges displayed are the extreme ranges available. Depending on the current camera operating conditions, you may not be able to obtain these values. If this occurs, values are clipped and the camera returns a warning message.

Some commands may not be available in your current operating mode. The help screen displays NA in this case.

Commands

The following table lists all of the camera’s available ASCII commands. Refer to Appendix A for detailed information on using these ASCII commands.

Table 16: Command Quick Reference

Mnemonic	Syntax	Parameters	Description
calibrate analog offset	cao	t i	Calibrates the analog gain and averages each tap’s pixels within the ROI to the specified average target value. t = tap selection, either 1 or 2 depending on camera model, or 0 for all taps i = target value in a range from 1 to 255DN (12 bit LSB)
correction calibrate fpn	ccf		1k and 2k models only. Performs FPN calibration and eliminates FPN noise by subtracting away individual pixel dark current.

Parameters:
t = tap id
i = integer value
f = float
m = member of a set
s = string
x = pixel column number
y = pixel row number

Mnemonic	Syntax	Parameters	Description
calculate camera gain	ccg	i t i	Calculates the camera gain according to the selected algorithm. i = Calibration algorithm to use. 1 = This algorithm adjusts analog gain so that 8% to 13% of tap ROI pixels are above the specified target value. 2 = This algorithm adjusts analog gain so that the average pixel value in tap's ROI is equal to the specified target value. 3 = This algorithm adjusts digital gain so that the average pixel value in tap's ROI is equal to the specified target. 4 = This algorithm adjusts the analog gain so that the peak tap ROI pixels are adjusted to the specified target. t = Tap value. Use 0 for all taps or 1 or 2 for individual tap selection depending on camera model. i = Calibration target value in a range from 1024 to 4055DN (12 bit LSB). 1k and 2k models only.
correction calibrate prnu	ccp		Performs PRNU calibration and eliminates the difference in responsivity between the most and least sensitive pixel creating a uniform response to light.

Mnemonic	Syntax	Parameters	Description
calculate PRNU algorithm	cpa	i i	Performs PRNU calibration according to the selected algorithm. The first parameter is the algorithm where i is: 1 = This algorithm first adjusts each tap's analog gain so that 8-13% of pixels within a tap are above the value specified in the target value parameter. PRNU calibration then occurs using the peak pixel in the region of interest. (Identical to ccp). 2 = Calculates the PRNU coefficients using the entered target value as shown below: $\text{PRNU Coefficient} = \frac{\text{Target}}{(\text{AVG Pixel Value}) - (\text{FPN} + \text{sdo value})}$ The calculation is performed for all sensor pixels but warnings are only applied to pixels in the region of interest. This algorithm is useful for achieving uniform output across multiple cameras. 3 = This algorithm includes an analog gain adjustment prior to PRNU calibration. Analog gain is first adjusted so that the peak pixel value in tap's ROI is within 97 to 99% of the specified target value. It then calculates the PRNU coefficients using the target value as shown below: $\text{PRNU Coefficient}_i = \frac{\text{Target}}{(\text{AVG Pixel Value}_i) - (\text{FPN}_i + \text{sdo value})}$ The calculation is performed for all sensor pixels but warnings are only applied to pixels in the region of interest. This algorithm is useful for achieving uniform output across multiple cameras. The second parameter is the target value to use in a range from 1024 to 4055DN.
correction set sample	CSS	m	Sets the number of lines to sample when using the gla command or when performing FPN and PRNU calibration where m is 256, 512, or 1024
display gpio configuration	dgc		Displays the current configuration of the GPIO connector.
display pixel coeffs	dpc	x1 x2	Displays the pixel coefficients in the order FPN, PRNU, FPN, PRNU, ... x1 = Pixel start number x2 = Pixel end number in a range from 1 to 1024 or 2048

Mnemonic	Syntax	Parameters	Description
enable input LUT	eil	i	Enable input LUT, where: 0 : Off 1 : On (4k model only.)
end of line sequence	els	i	Sets the end-of-line sequence: 0 : Off 1 : On
enable pixel coefficients	epc	i i	Sets whether pixel coefficients are enabled or disabled. The first parameter sets the FPN coefficients where i is: 0 = FPN coefficients disabled 1 = FPN coefficients enabled The second parameter sets the PRNU coefficients where i is: 0 = PRNU coefficients disabled 1 = PRNU coefficients enabled
get camera model	gcm		Reads the camera model number.
get camera parameters	gcp		Reads all of the camera parameters.
get camera serial	gcs		Read the camera serial number.
get camera version	gcv		Read the firmware version and FPGA version.
get fpn coeff	gfc	x	Read the FPN coefficient x = pixel number to read in a range from 1 – sensor pixel count .
get help	gh		Returns all of the available “get” commands.
get input LUT	gil		Display the current LUT set number. (4k model only.)
get line	gl	x x	Gets a line of video (without pixel coefficients applied) displaying one pixel value after another and the minimum, maximum, and mean value of the sampled line. x = Pixel start number x = Pixel end number in a range from 1 to sensor pixel count .
get line average	gla	x x	Read the average of line samples. x = Pixel start number x = Pixel end number In a range from 1 to sensor pixel count .
get prnu coeff	gpc	x	Read the PRNU coefficient. x = pixel number to read in a range from 1 – sensor pixel count .

Mnemonic	Syntax	Parameters	Description
get signal frequency	gsf	i	Reads the requested Camera Link control frequency. 1 = EXSYNC frequency 2 = Spare 3 = Direction 4 = Spare
get status led	gsl		Returns the current state of the camera's LED where: 1 = Red 2 = Green 5 = Blinking green 6 = Blinking red
help	h		Display the online help.
load pixel coefficients	lpc		Loads the previously saved pixel coefficients from non-volatile memory where i is: 0 = Factory calibrated coefficients 1 = Coefficient set one 2 = Coefficient set two 3 = Coefficient set three 4 = Coefficient set four
reset camera	rc		Resets the entire camera (reboot). Baud rate is not reset and reboots with the value last used.
restore factory settings	rfs		Restores the camera's factory settings. FPN and PRNU coefficients reset to 0.
region of interest	roi	x y x y	Sets the pixel range affected by the cag , cao , gl , gla , ccf , and ccp commands. The parameters are the pixel start and end values (x) and the column start and end values (y) in a range from 1 to sensor pixel count .
reset pixel coeffs	rpc		Resets the pixel coefficients to 0.
restore user settings	rus		Restores the camera's last saved user settings and FPN and PRNU coefficients.
set analog gain	sag	t f	Sets the analog gain in dB. t = tap selection, either 1 or 2 depending on camera model, or 0 for all taps. f = gain value specified from -10 to +10 (1k and 2k models only.)

Mnemonic	Syntax	Parameters	Description
set analog offset	sao	t i	Sets the analog offset. t = tap selection, either 1 or 2 depending on camera model, or 0 for all taps. i = Offset value in a range from 0 to 255 (12-bit LSB). Offset increases with higher values.
set binning horizontal	sbh	m	Sets the horizontal binning value. Available values are 1 and 2.
set baud rate	sbr	i	Set the speed of camera serial communication port. Baud rates: 9600, 19200, 57600, and 115200. Default: 9600.
set ccd direction	scd	i	Sets the CCD shift direction where: 0 = Forward CCD shift direction. 1 = Reverse CCD shift direction. 2 = Externally controlled direction control via CC3.
set data mode	sdm	i	Sets the camera's bit width where: <i>For SG-11-01K40 and SG-11-02K40</i> 0 = 8 bits, 1 tap, 40MHz data rate 1 = 12 bits, 1 tap, 40MHz data rate <i>For SG-11-01K80, 02k80, and 04K80</i> 2 = 8 bits, 2 taps, 80Mhz data rate 3 = 12 bits, 2 taps, 80MHz data rate
set digital offset	sdo	t i	Subtracts the input value from the video signal prior to FPN correction. t = tap selection, either 1 or 2 depending on camera model, or 0 for all taps. i = Offset in a range from 0 to 2048DN.
set exposure mode	sem	m	Sets the exposure mode: 2 = Internal SYNC, internal PRIN, programmable line rate and exposure time using commands ssf and set 3 = External SYNC, internal PRIN, maximum exposure time 4 = Smart EXSYNC 5 = External SYNC and PRIN 6 = External SYNC, internal PRIN, programmable exposure time 7 = Internal programmable SYNC, maximum exposure time. Factory setting. 8 = Internal SYNC, internal PRIN, programmable exposure time. Maximum line rate for exposure time.

Mnemonic	Syntax	Parameters	Description
set exposure time	set	f	Sets the exposure time. Refer to the camera help screen (h command) for allowable range.
set fpn coeff	sfc	x i	Set the FPN coefficient. x = pixel number within the range 1 to sensor pixel count . i = FPN value within the range 0 to 2047 (12-bit LSB).
set GPIO input	sgi	i1 i2	Sets the GPIO input signal. i1 = input number in a range from 0 to 3 i2 = signal to use where: 0 = disabled 1 = TTL 2 = LVDS Note: sgi 3 2 is not available.
set GPIO output	sgo	i1 i2	Sets the GPIO output signal. i1 = output number in a range from 0 to 3 i2 = output signal to use where: 0 = disabled 1 = TTL 2 = LVDS PUT NOTE here that sgi 3 2 is not available
set lower threshold	slt	i	The pixels below the lower threshold are checked for and reported in the end-of-line sequence in a range from 0-4095 .
set prnu coeff	spc	x i	Set the PRNU coefficient. x = pixel number within the range 1 to sensor pixel count . i = PRNU value within the range 0 to 28671 .
set readout mode	srn	i	Set the readout mode in order to clear out dark current charge in the vertical transfer gates before the sensor is read out. 0 = Auto. 1 = Dark current clear. 2 = Immediate readout. Does not clear dark current.
set subtract background	ssb	t i	Subtract the input value from the output signal. t = Tap value. 0 for all taps or 1 to <i>number of camera taps</i> for individual tap selection. i = Subtracted value in a range from 0 to 4095 .

Mnemonic	Syntax	Parameters	Description
set sync frequency	ssf	i	Set the frame rate to a value from 300 Hz to 36000 Hz (2k model) or 300 Hz to 68000 Hz (1k model). Value rounded up/down as required.
set system gain	ssg	t i	Set the digital gain. t = tap selection, either 1 to 2 , or 0 for all taps i = Digital gain in a range from 0 to 65535 . (4k limit is 12953.) The digital video values are multiplied by this number.
set sensitivity mode	ssm	i	Sets the camera's sensitivity mode where i is: 0 = Low sensitivity mode 1 = High sensitivity mode 2 = Tall pixel mode
set upper threshold	sut	i	The pixels equal to or greater than the upper threshold are checked for and reported in the end-of-line sequence in a range from 0-4095 .
set video mode	svm	i	Switch between normal video mode and camera test patterns: 0 : Normal video mode 1 : Camera test pattern 2 : Camera test pattern
update gain reference	ugr		Changes 0dB gain to equal the current analog gain value set with the sag command.
verify temperature	vt		Check the internal temperature of the camera
verify voltage	vv		Check the camera's input voltages and return OK or fail
write FPN coefficients	wfc	i	Write all current FPN coefficients to EEROM where i is: 1 = FPN coefficient set one 2 = FPN coefficient set two 3 = FPN coefficient set one 4 = FPN coefficient set two
write PRNU coeffs	wpc	i	Write all current PRNU coefficients to EEROM where i is: 1 = PRNU coefficient set one 2 = PRNU coefficient set two 3 = PRNU coefficient set one 4 = PRNU coefficient set two
write user settings	wus		Write all of the user settings to EEROM.

Appendix D

Troubleshooting

The information in this chapter can help you solve problems that may occur during the setup of your camera. Remember that the camera is part of the entire acquisition system. You may have to troubleshoot any or all of the following:

- power supplies
- Ethernet hardware & software
- light sources
- operating environment
- cabling
- host computer
- optics
- encoder

LED

When the camera is first powered up, the LED will glow on the back of the camera. Refer to section **Error! Reference source not found.** for information on the LED.

Connections

The first step in troubleshooting is to verify that your camera has all the correct connections. Refer to section

Cable Length/Type

Ensure that cable lengths are no longer than 100m.

Equipment Requirements

Ensure that you are using compatible equipment, as outlined in section 3.2 Equipment Recommendations.

Power Supply Voltages

Check for the presence of all voltages at the camera power connector. Verify that all grounds are connected. Refer to the Diagnostics tab in QuickCam to verify your voltage level.

EXSYNC

When the camera is received from the factory, it defaults (no external input required) to exposure mode 7 (5000 Hz line rate, internal Sync to trigger readout). After a user has saved settings, the camera powers up with the saved settings.

If you change to an exposure mode that requires an external sync, then ensure that you properly providing an external sync

Camera Operation and Test Patterns

To validate camera and Ethernet connections, have the camera send out a test pattern and verify that it is being properly received.

To send a test pattern:

Under **Test Pattern** on the **Diagnostics** tab in QuickCam:

1. Select a test pattern from the **Camera** dropdown box to confirm camera functionality.

Communications and Verify Parameters

To quickly verify serial communications, check the **Diagnostics tab** in QuickCam. Communication is working properly if the camera settings are properly displayed in the **Camera Settings** section.

Verify Voltage

To check the camera's input voltage, refer to the **Temperature/Voltage** section on the **Diagnostics tab** in QuickCam.

Verify Temperature

To check the internal temperature of the camera, refer to the **Temperature/Voltage** section on the **Diagnostics tab** in QuickCam. The camera will shut itself down if the internal temperature exceeds 75°C.

QuickCam Message Window

Refer to the Message Window in QuickCam for a list of messages sent from the camera and a list of all commands sent to the camera.

Create an Error Report

You can create an error report in order to review test patterns and xml log files sent from the camera. This is useful for your own information as well as when you have to contact Product Support.

To create an error report:

1. Click the  button on QuickCam toolbar.

In the **Save As** dialog box:

2. Select the location on your computer to save the file.
3. In the **File name** text box, enter a name for the error report.

4. Click **Save**.

To view the error report:

1. Select **View → Error Report**.

In the Open dialog box:

2. In the **Look in** list, click the drive or folder that contains the error report you want to open.
3. In the folder list, locate and open the folder that contains the error report.
4. Click the error report, and then click **Open**.

Specific Solutions

No Output or Erratic Behavior

If your camera provides no output or behaves erratically, it may be picking up random noise from long cables acting as antennae. Do not attach wires to unused pins. Verify that the camera is not receiving spurious inputs (e.g. EXSYNC if camera is in exposure mode that requires external signals).

Line Dropout, Bright Lines, or Incorrect Line Rate

Verify that the frequency of the internal sync is set correctly, or when the camera is set to external sync that the EXSYNC signal supplied to the camera does not exceed the camera's useable Line rate under the current operating conditions.

Noisy Output

Check your power supply voltage outputs for noise. Noise present on these lines can result in poor video quality.

Dark Patches

If dark patches appear in your output the optics path may have become contaminated. Clean your lenses and sensor windows with extreme care.

1. Take standard ESD precautions.
2. Wear latex gloves or finger cots
3. Blow off dust using a filtered blow bottle or dry, filtered compressed air.
4. Fold a piece of optical lens cleaning tissue (approx. 3" x 5") to make a square pad that
5. is approximately one finger-width
6. Moisten the pad on one edge with 2-3 drops of clean solvent—either alcohol or acetone. Do not saturate the entire pad with solvent.
7. Wipe across the length of the window in one direction with the moistened end first, followed by the rest of the pad. The dry part of the pad should follow the moistened

end. The goal is to prevent solvent from evaporating from the window surface, as this will end up leaving residue and streaking behind.

8. Repeat steps 2-4 using a clean tissue until the entire window has been cleaned.
9. Blow off any adhering fibers or particles using dry, filtered compressed air.

Horizontal Lines or Patterns in Image

A faulty or irregular encoder signal may result in horizontal lines due to exposure time fluctuations; ensure that your exposure time is regular. If you have verified that your exposure time is consistent and patterns of low frequency intensity variations still occur, ensure that you are using a DC or high frequency light source.

Product Support

If there is a problem with your camera, collect the following data about your application and situation and call your DALSA representative.

Note: You may also want to photocopy this page to fax to DALSA.

Customer name	
Organization name	
Customer phone number fax number email	
Complete Product Model Number (e.g. SG-11-01k40-00-R)	
Complete Serial Number	
Your DALSA Agent or Dealer	
Acquisition System hardware (frame grabber, host computer, light sources, etc.)	
Power supply setting and current draw	
Data rate used	
Control signals used in your application, and their frequency or state (if applicable)	☐ EXSYNC ☐ BIN ☐ LVDS/TTL ☐ Other _____
Results when you run an error report	<i>please attach text received from the camera after initiating an error report</i>
Detailed description of problem encountered.	<i>please attach description with as much detail as appropriate</i>

In addition to your local DALSA representative, you may need to call DALSA Technical Sales Support:

	North America	Europe	Asia
Voice:	519-886-6000	+49-8142-46770	+1-519-886-6000
Fax:	519-886-8023	+49-8142-467746	+1-519-886-8023
Email:	support@dalsa.com	support@dalsa.com	support@dalsa.com

Appendix E

Revision History

Revision Number	Change Description
00	Preliminary release.
01	4k version of camera, content, added.
02	Preliminary stamp removed.

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